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VOL. XIV ST. LOUIS, JANUARY, 1928 No. 1

ORIGINAL ARTICLES

THE PERIDENTAL UNIT*

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THE underlying thought in this paper is the presentation of a group of tissues which, although different anatomically, assume through their associated functions the status of an entity. The peridental unit, for the purpose of this presentation, may be said to consist of the *alveolar bone, the peridental fibers,* and the *cementum.* These tissues comprise one functional unit as regards the biologic and mechanical aspects. They have a common origin and are closely interrelated both in health and in disease.

ORIGIN

The tissues which make up the peridental unit are derived from the mesoderm. They have, because of this fact, a wide range of adaptability. This is in marked contrast to the ectodermic tissue of the tooth, the enamel, whose growth is virtually completed after eruption of the crown and which has no power of regeneration. On the other hand, the mesoblastic cementum, peridental membrane, and alveolar bone are undergoing changes throughout life, changes which are not only of regressive, but also of a constructive character. Embryonic mesoblastic cells are found in the peridental membrane at all times, ready to be differentiated under the proper stimuli into osteoblasts to build new bone, into cementoblasts to build cementum, or into fibroblasts to form fibers. Under other stimuli they may be differentiated into osteoclasts or cementoclasts for the purpose of resorbing those structures.

ANATOMY

Bone.—The surface of the bone consists of parallel layers, called subperiosteal bone. (Fig. 1.) These layers are responsible for the surface growth

*Read before the Twenty-sixth Annual Meeting of the American Society of Orthodontists, Chicago, May 2-5, 1927.

of the bone; that is, deposition of the layers is the means by which the size of the bone is increased, while absorption of them reduces the size. The interior of the bone consists of haversian systems with their concentric layers. (Fig. 2.) The systems are responsible for the *interstitial growth* of the bone. They are arranged to form trabeculae and are an excellent means of making possible various changes in the structure of the bone.

The haversian systems have a short life; old systems are constantly being resorbed and replaced by new ones. (Figs. 3 and 4.) The young systems contain much organic substance and are therefore relatively elastic. As they get older, lime salts are deposited in them and consequently they lose their

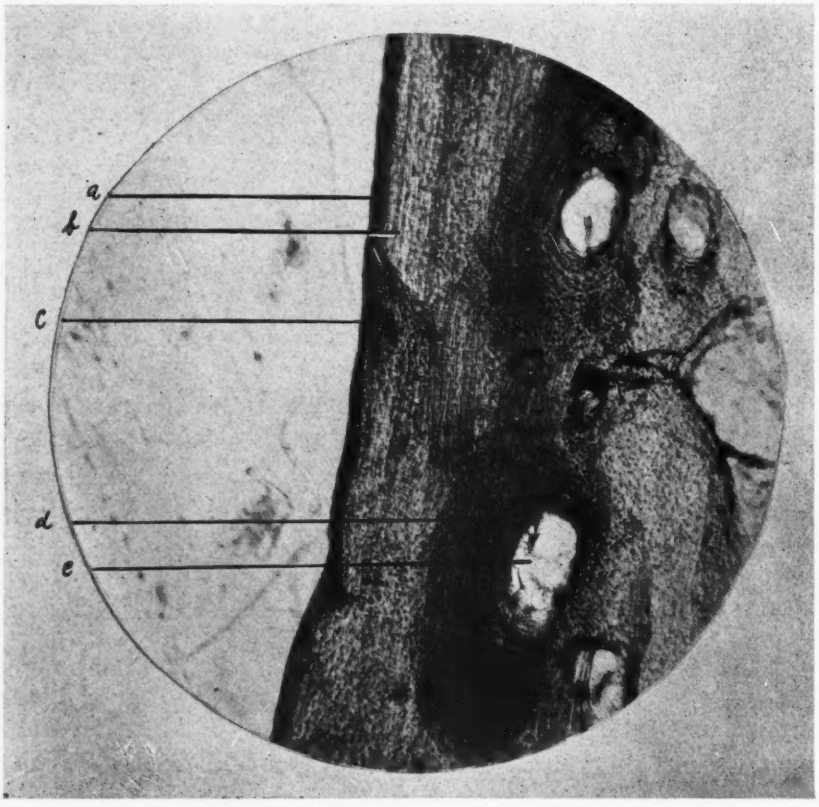


Fig. 1.—Subperiosteal bone. Parallel layers of bone on the surface; haversian systems in the deeper parts. *a*, periosteum; *b*, subperiosteal bone; *c*, Volkman's perforating canal; *d*, haversian system; *e*, haversian canal.

elasticity, which seems to be a factor leading to their resorption. Another factor in resorption and deposition is the stimulus provided by function. Variations in stress may involve increase or decrease in the number of trabeculae, in their size, or changes in their direction.

Bone is a structure for *support*. The jaw bone is intended for the support of the teeth. Heavy function requires a strong support and stimulates deposition. Under this stimulation, new trabeculae are built, and existing trabeculae become thicker. (Fig. 5.) In that way, the interstitial growth regulates the density of the bone. The trabecular structure not only changes according to the amount of stress, but also according to its direction. The

trabeculae are supporting structures comparable to supporting beams and are laid down in such direction and arrangement as will best serve for the performance of this function. They are built under the influence of mechanical laws and (following the general law of economy and efficiency in Nature's household) develop only such bulk as will enable them to withstand the stresses which are brought to bear upon them. Throughout the bones of the body, this law has been studied. One of the best examples is afforded by the head of the femur which sustains the body weight. (Fig. 6.) The arrangement of the bone trabeculae is such as to provide adequate support for certain stresses, in certain directions, with the minimum of bulk.

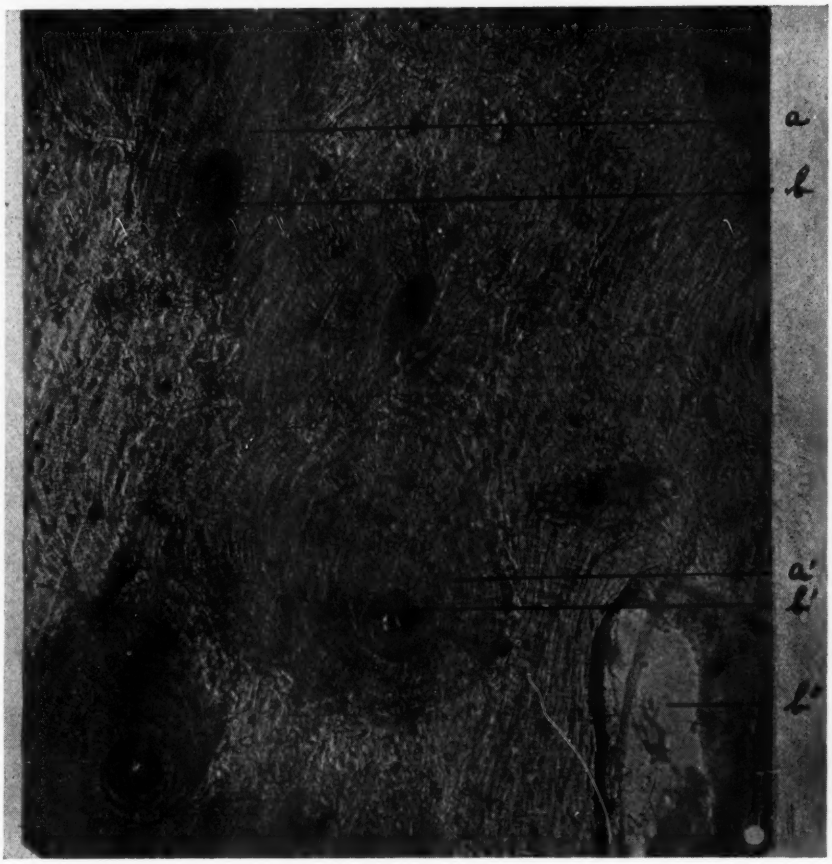


Fig. 2.—Haversian systems, larger magnification, *a*, *a'*, concentric layers of bone with bone cells; the long side of the cells faces the canal; *b*, *b'*, haversian canal; *b''*, larger canal.

Another example of the manner in which trabeculae are given a definite arrangement for the performance of a certain mechanical function can be seen in the changes which occurred in the palatal suture of a dog when experimental widening was produced by an appliance. (Fig. 7.) The palatal suture is made up of tightly interlocking trabeculae of bone, between which there is connective tissue, containing osteoblasts and embryonic mesoblastic cells. (Fig. 8.) These trabeculae, developed according to the mechanical laws of masticatory stresses, changed when the expanding stress of the appliance

was introduced. They developed in the direction of the new force, and became long, finger-like extensions. (Fig. 9.)

The trabeculae of the alveolar process and, in fact, of the whole jaw, are subject to these laws. Every element has a definite *size and direction,* dependent upon the stress to which it is subjected. Change of this stress produces change in its size or direction. Since the resorption of existing haversian systems and the formation of new systems are constantly going on, changes in the direction and the size of the trabeculae may take place quite rapidly. Thus, it is found that bone, which is usually regarded as the least plastic tissue in the body, is actually the most plastic. In fact, as regards response to mechanical stimuli, bone is more plastic even than the gingiva, which is re-

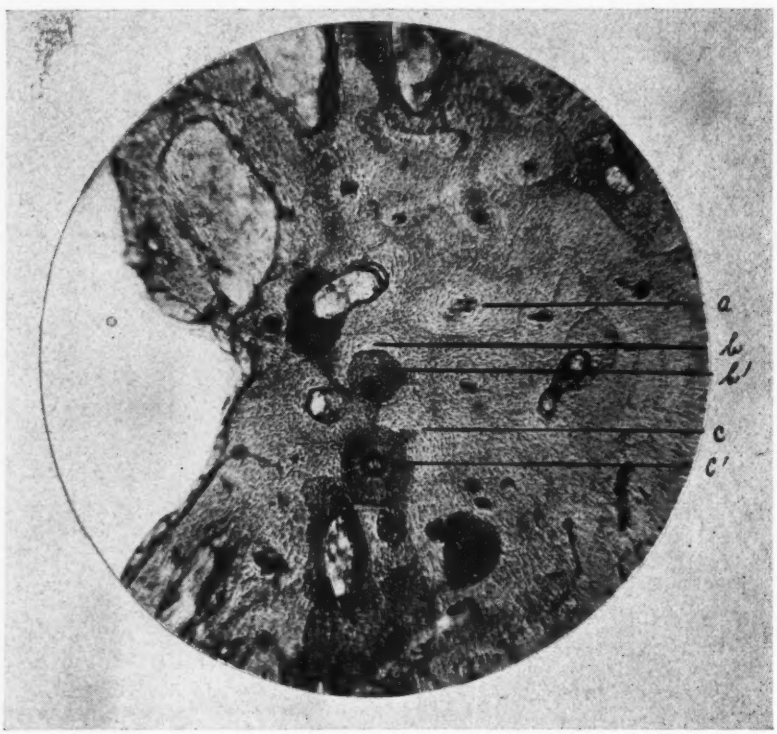


Fig. 3.—Interstitial bone growth. Old systems (*a*, *b*, *c*+) light in shade, together with new replacing systems (*b'*, *c'*+) darker in shade, demonstrate the continuous changes going on in bone. The difference in staining is due to a chemical difference of the ground substance of old and new bone.

garded as a characteristically soft tissue. Orthodontists are familiar with the ease and rapidity with which alveolar bone is resorbed and deposited as teeth are moved; and they are also familiar with the slow resorption of gingival tissue which may be thrown into folds when teeth have been moved a long distance or when previously separated teeth are brought into apposition.

Furthermore, the influence of functional stresses is not limited to the bone in the immediate neighborhood of the tooth. Changes in the trabecular structure take place simultaneously throughout the whole jaw bone in accordance with mechanical laws. The bone supporting the teeth, and the bone on which the muscles of mastication are inserted, and the bone between these points, all constitute *one mechanical system.* Stronger development of the alveolar

part of the bone without development of the other parts would not increase the masticatory efficiency of the jaw structure. Changes may have their inception in the bone immediately adjacent to the teeth, but changes initiated in this region are projected throughout the jaw, and compensating changes are at once inaugurated for the reestablishment of equilibrium. (Fig. 5, left side.)

Much mischief has been done through the promulgation of the idea that the alveolar process is a division of the jaw having a different character than the rest of the jaw bone (Cryer, etc.), as also the hypothesis of an "apical base" (Lundstrom). There is no foundation in fact supporting either of these

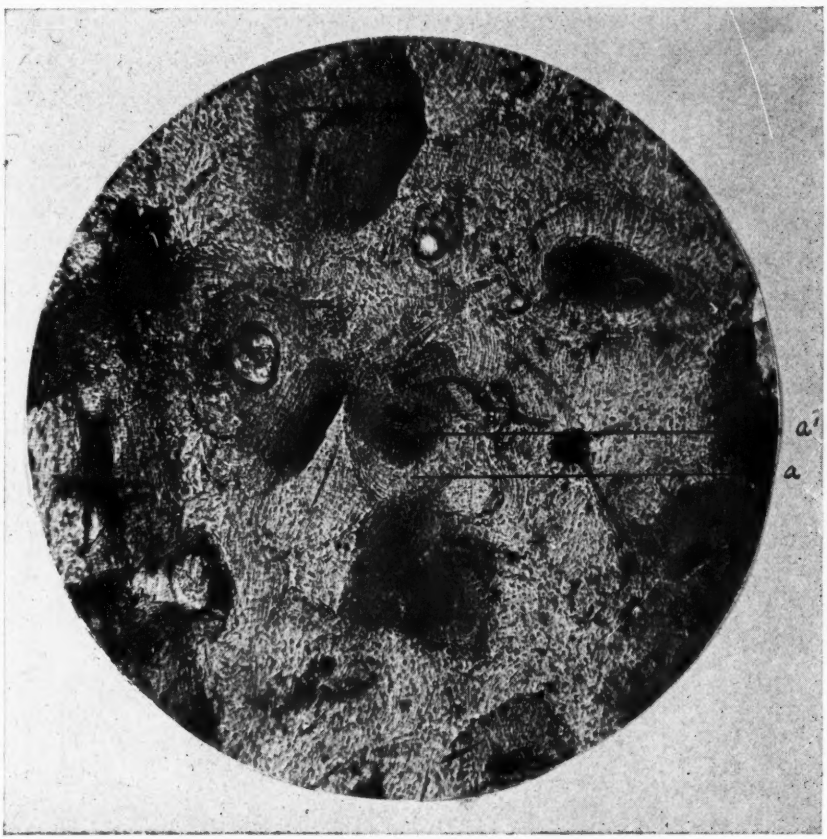
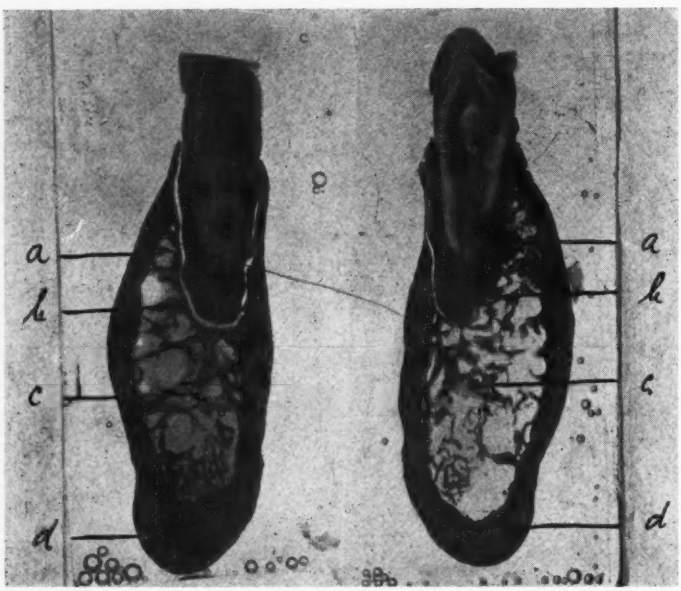


Fig. 4.—Interstitial growth of bone, larger magnification. The old system (*a*) is being replaced by the newly built system (*a'*).

ideas. There is absolutely no line of demarcation between any parts of the jaw bone, and its trabecular structure is continuous and integrated. (Fig. 10).

If the alveolar process is reinforced under the influence of better function, this reinforcement is carried through the whole mandible or maxilla as far as the point of muscle insertion, and if such insertions are on adjacent bones, as is the case with the maxilla, they are carried even far beyond the masticatory bases and throughout the entire temporomandibular apparatus. (Fig. 11.) For instance, expansion of the alveolar process cannot be produced without also inducing rearrangement and corresponding expansion of the whole mandible and maxilla.

Underdevelopment of the so-called "apical third" is therefore no contraindication for orthodontic treatment, as some orthodontists have stated, but indeed, a very strong indication for it. Because the underdevelopment is directly traceable to malocclusion, with the consequent impaired function, the building up of this underdeveloped structure cannot be expected until the malocclusion has been treated and function has thus been brought up to a



Left Right

Fig. 5.—Unilateral mastication. Sections through molars of a jaw which had occlusion on left side only. Heavier development of bone throughout the jaw on this side. *a*, alveolar process; *b*, alveolar wall; *c*, cancellous bone; *d*, border of mandible.

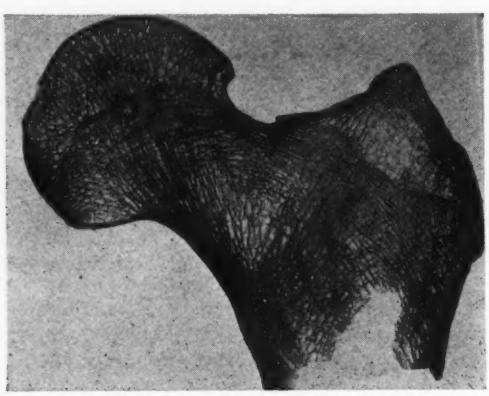


Fig. 6.—Femur head. The trabeculae of bone are developed like supporting beams, according to the lines of forces. (Freiberg.)

normal level. It is understood, however, that if the weakness is due to a systemic disease, endocrine disturbance, or malnutrition, these disturbances must be treated before the malocclusion is treated. The process of growth is an intricate one and dependent upon the proper correlation of interacting biologic, chemical, and mechanical factors.

Cementum.—The cementum has a structure similar to that of subperiosteal

bone. It consists of circumferential layers, laid down on the surface of the root, thereby providing an unbroken lamellar structure. The deposition of cementum goes on all the time, but, like every growth, it goes on in certain periods more rapidly and more actively than in others; and though the process is absolutely continuous, the resulting cementum has the appearance of having been laid

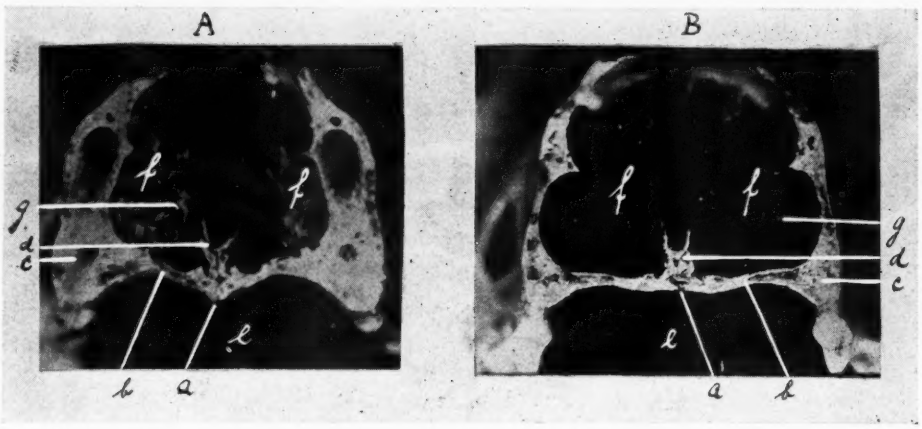


Fig. 7.—Palatal suture of dog. *A*, normal; *B*, after treatment. Section cut in region of first premolar. Bone growth occurred in the suture (*a*); note also change in the curve of the palatal process of the maxillary bone (*b*); *c*, body of maxillary bone; *d*, vomer; *e*, oral cavity; *f*, nasal cavity; *g*, turbinated bodies.

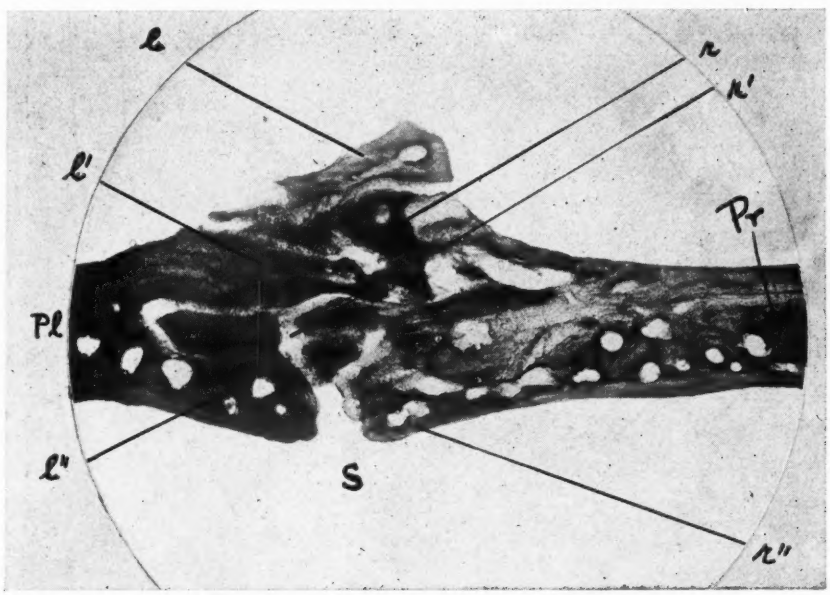


Fig. 8.—Normal suture. Section cut in region of first premolar. *Pl* and *Pr*, palatal processes of left and right maxillary bone; *S*, palatal suture; the interlocking trabeculae (*l*, *l'*, *l''* and *r*, *r'*, *r''*) are short.

down in layers. Cementum exhibits an important biologic difference from bone: it is normally never resorbed. The old layers are prevented from resorption by the deposition of new ones (Gottlieb). Thus, the root grows during the whole life, stimulated through the influence of normal function. Lack of function and cessation of normal stimulation bring cementum deposi-

tion to a standstill and may introduce the danger of root absorption. Heavy function, on the other hand, providing it is within normal limits, produces heavy deposition which thus may be called hypercementosis.

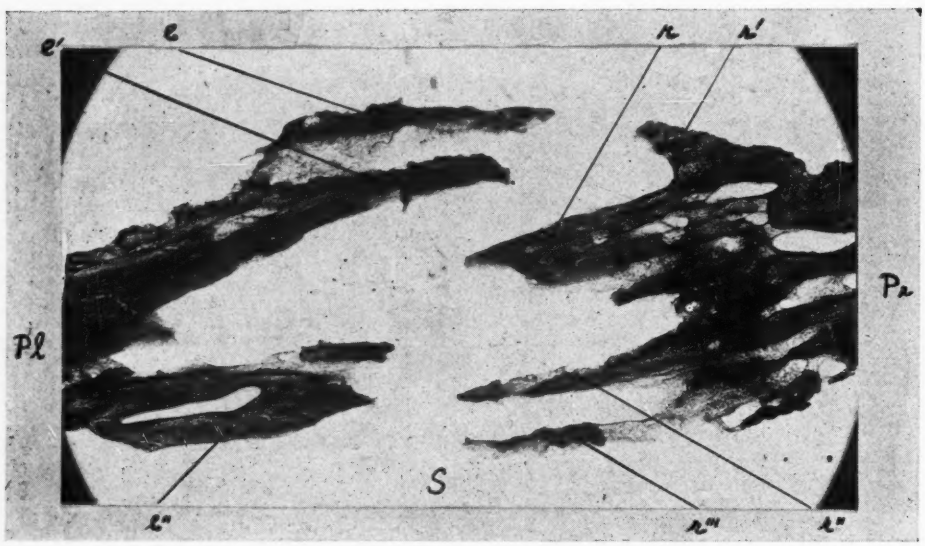


Fig 9.—Bone growth in suture. Section cut in region of first premolar. The trabeculae have grown in the direction of force into long finger-like extensions (*l*, *l'*, *l''* and *r*, *r'*, *r''*, *r'''*) ; *Pl* and *Pr*, palatal processes of left and right maxillary bone ; *S*, palatal suture.

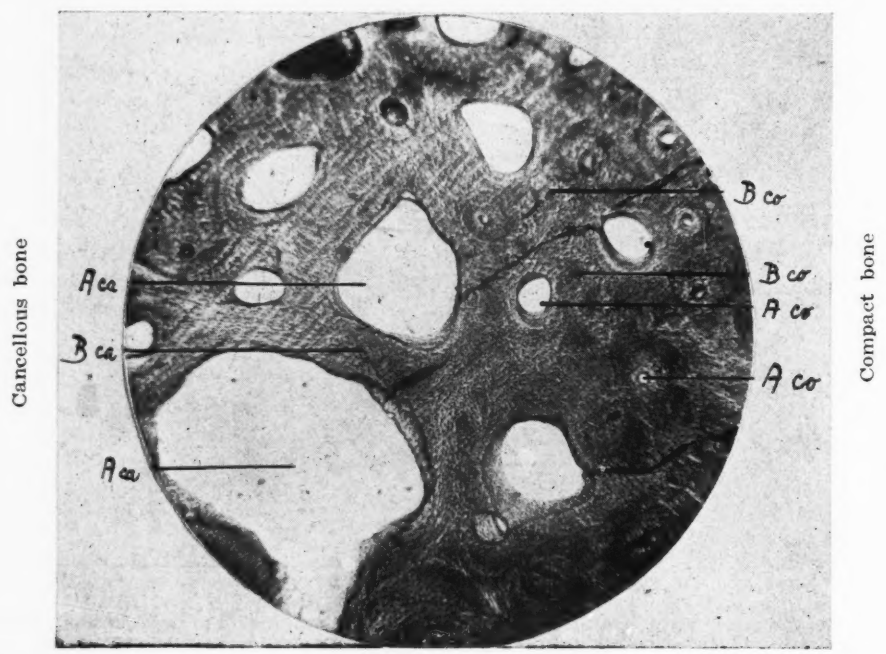


Fig. 10.—Continuity of trabecular structure in so-called "compact" and "cancellous" bone. *Aca*, canals in cancellous part (large). *Aco*, canals in compact part (small) ; *Bca*, trabeculae in cancellous part (small) ; *Bco*, trabeculae in compact part (large).

Peridental Fibers.—From the viewpoint of its place in the peridental unit, the pericementum is of interest chiefly because of its suspending fibers. These fibers are invested in the cementum at one end and in the bone at the other.

(Fig. 12.) The tooth, and particularly here the root surface, acts as an "organizer" of tissues (Noble) inducing the connective tissue, by means of a specific stimulation, to develop suspending fibers. As the fibers are formed, they are invested in calcified material at both ends. Also, these fibers are continuously changing in conformity with the deposition of new cementum and new bone. Although no elastic material has been traced in the fibers, convolutions have been described which allow a certain amount of stretching. This is of importance in the performance of function. The fibers introduce the factor of suspension into the peridental unit. They convert *occlusal pressure* into *peridental tension.*

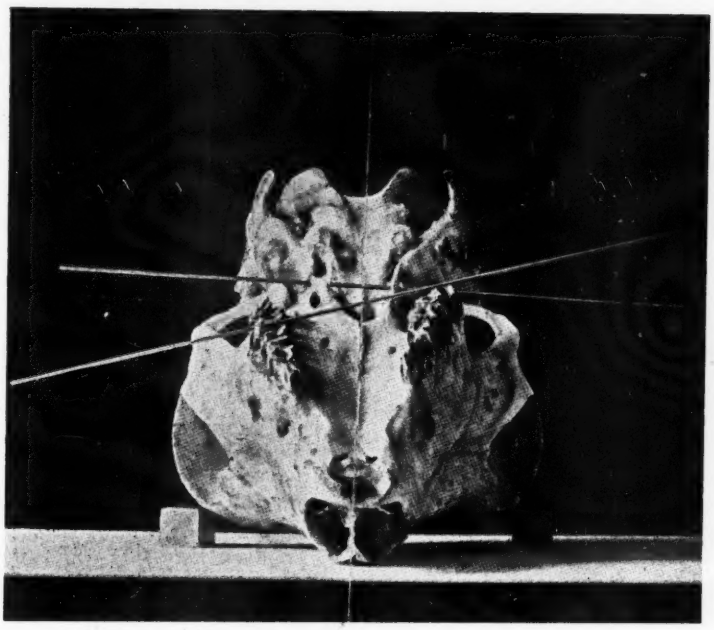


Fig. 11.—Skull of sheep. The right side was without occlusion due to experimental cutting off of mandibular teeth. The influence of mastication can be seen in the difference in the development of the right and left sides. (Baker.)

PHYSIOLOGY

Normal function takes place when the tooth, through the action of its antagonist, moves slightly in the alveolus towards the apex, until the peridental fibers are stretched and the suspensory support of the alveolar bone is engaged. Functional stresses are exerted upon the tooth in several directions. The most important is the *vertical stress,* chiefly exercised during mastication or in the occlusal contact of the jaws in simple closing. In addition, there is a *lateral stress* of varying obliquity, also exerted during mastication or closing of the jaws and produced by the lateral excursions due to the formation of the occlusal surfaces. Other stresses are the *horizontal stresses* exerted by the cheeks, lips, and tongue.

Stresses in Normal Position and Malposition.—In normal occlusion, most of the functional stresses are those in a vertical direction, and they engage the peridental unit so as to insure an even distribution of the force. A stretching of the fibers occurs on all sides of the tooth and so provides for

a functioning of the bone in every part of the alveolar wall. (Fig. 13-*A*.) The lateral stresses are largely taken up by the approximal contact with other teeth, the inclination of the teeth in the jaw bone, and the divergence of the roots. Where these factors are insufficient, the remaining stress is taken up by localized portions of the membrane, thus tending to unequal stimulation and unequal development of bone, fibers, and cementum in those regions. This tendency to unequal development, however, is overcome in normal occlusion by the fact that the lateral stresses are balanced. A stress from the lingual

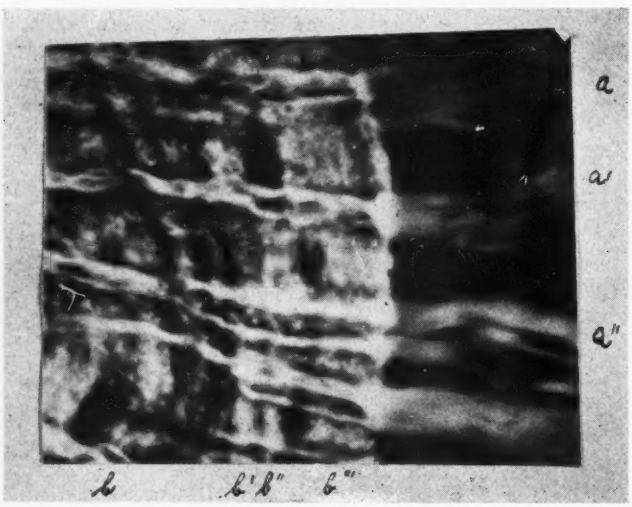


Fig. 12.—Insertion of peridental fibers in cementum. *a*, *a'*, *a''*, fibers; *b*, *b'*, *b''*, *b'''*, cementum layers. (Gottlieb.)

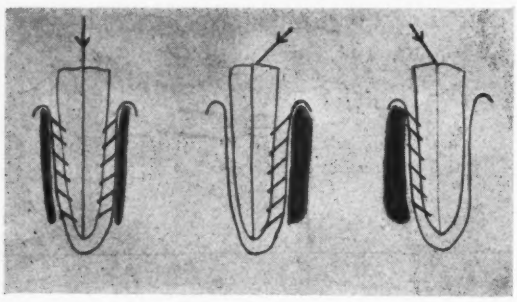


Fig. 13.—Tooth in normal vertical position; functional stimuli equally distributed. *a*, force acting in the direction of the long axis; *b*, force acting from the lingual; *c*, force acting from the buccal. (Black area signifies bone under function.)

side is compensated for by one from the buccal, a stress in a mesial direction by one in a distal direction. (Figs. 13-*B* and *C*.)

In order to understand the action of lateral forces upon teeth which are in malposition, it is necessary to analyze the action of these forces upon the normal tooth. When a force acts from the labial side, the peridental unit mainly functions on the labial side, the fibers being stretched and the bone of the labial wall giving support. Under certain conditions, however, and to a slight degree under every stress, the tooth acts like a lever, and with the stretching of the fibers of the gingival third of the labial side, there is a slight stretching of fibers in the apical third of the lingual side, the middle

of the root acting as the fulcrum. In every instance the stretching of peridental fibers under influence of stress is accompanied by engagement of supporting bone on the side *from which* the tooth is being moved. This principle of functional tension as the means of tooth support can readily be observed on the root of a rodent incisor, in which the development of bone in the regions of pull can be clearly followed. (Fig. 14.)

A severe disturbance of this balance of stresses is found in malposition of teeth. This is most strikingly shown when teeth are tipped, in which case even vertical forces fail to act in the long axis of the tooth, and lateral stresses are quite unbalanced. (Fig. 15.) These forces, furthermore, have

Fig. 14.—Rodent incisor. Heavy bone in regions of pull; lingual side of anterior part of incisor (*a*) and buccal side of posterior part (*b*).

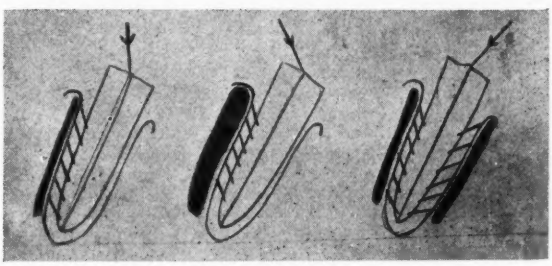


Fig. 15.—Tooth in abnormal lingual inclination; stimuli applied mainly to buccal side. *a*, vertical force; *b*, force acting from the buccal; *c*, force acting from the lingual. (Black area signifies bone under function.)

a tendency to increase the malposition, and thus a vicious circle is established. As a result, one part of the unit is invariably subjected to greater stresses than the rest. In lingual inclinations, for instance, it is chiefly the labial side of the occlusal third (and to some degree, the lingual side of the gingival third) of the unit which takes up the unbalanced stresses and receives heavy function. If this function does not exceed the reserve power of the unit, then we find the bone in this localized part heavily developed, the cementum thick, and the peridental fibers long. (Figs. 16 and 17.) On the opposite side, the unit is poorly developed and resorptions of bone and cementum take place.

TREATMENT

To understand the changes which take place in the peridental unit during orthodontic treatment, we must recall the fact that normal conditions are dependent upon normal function. Under the influence of functional stimulation the bone is well developed, the membrane has strong suspensory fibers, and the cementum is continuously deposited. The bone is arranged with its trabeculae running parallel to the long axis of the tooth, in accordance with the direction of the main stresses.

Three principal changes take place under the influence of orthodontic appliances, as far as the tooth biology is concerned.

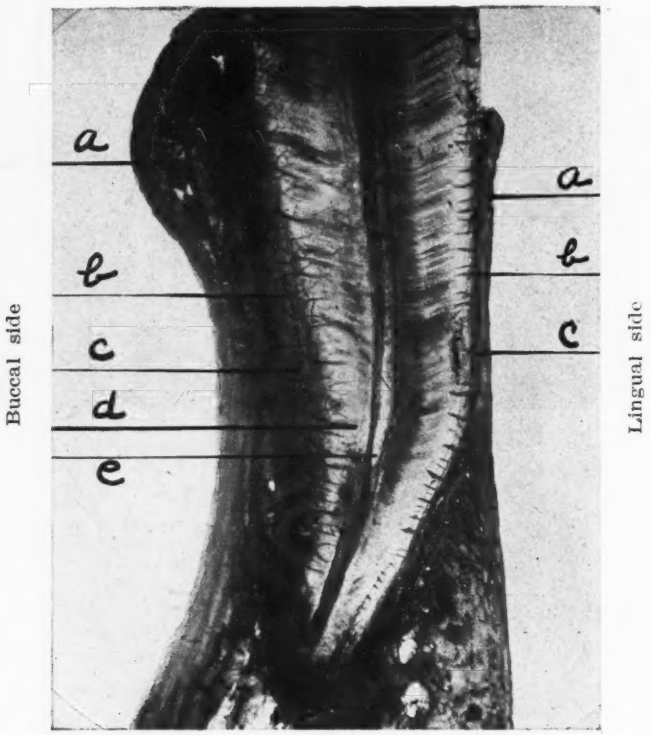


Fig. 16.—Section of lateral incisor in linguoversion. Peridental unit well developed on buccal, poorly developed on lingual side. *a*, bone; *b*, fibers; *c*, cementum; *d*, dentin; e, pulp.

A general change is the *decrease in function;* first, because the patients eat softer food; second, because the appliance and its attachments prevent, to a certain degree, the physiologic mobility of the teeth. Those minute movements of the tooth in its alveolus, which put the fibers on a stretch and engage the alveolar bone, are of vital importance to the unit; and it also is most important that the tooth have mobility in every direction. Attachments disturb this mobility, and the more rigidly they hold the tooth, the more they prevent its functional mobility until, sometimes, they do not allow even the slightest movements. The result is a severe disturbance of the unit, an atrophy of the bone, absorption of the cementum, and destruction of the membrane. This is clinically manifested in the loosening of the tooth.

To this disturbance comes the specific change through the introduction of a new force, *pressure.* Through the pressure exerted by the appliance, changes occur in the bone in the way of bone absorption and of rearrangement of its trabecular structure. The new trabeculae are an indication of the formation of what may be called pressure bone, and this type of bone, though normal in other parts of the body, is abnormal in the jaw. Never in the act of normal mastication is pressure exerted against the alveolar wall. Hence, this structure consists of an arrangement of trabeculae which may be called tension bone. The more rapidly the tooth movement is accom-

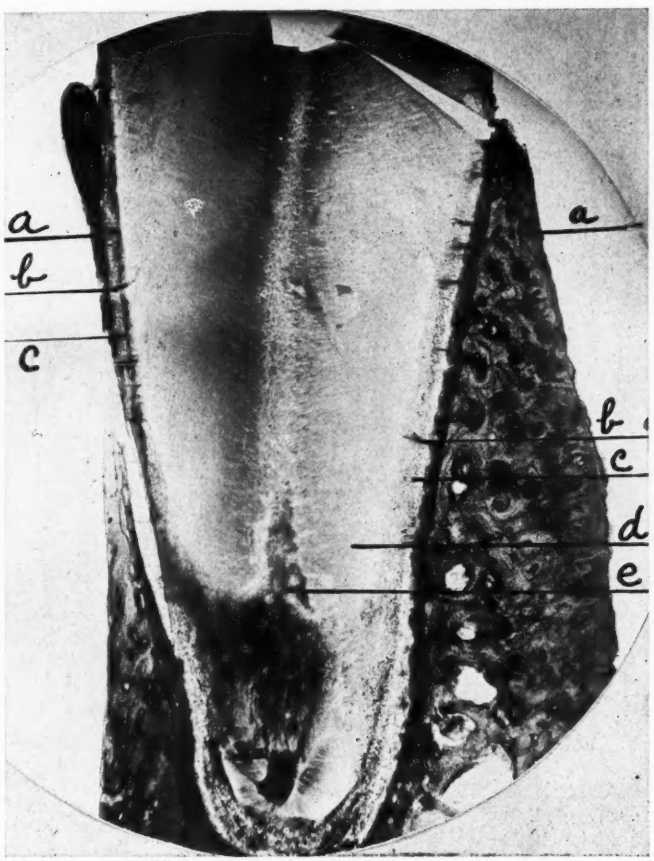


Fig. 17.—Section of canine; poor development of buccal plate due to disturbed mobility in lingual direction. *a,* bone; *b,* fibers; *c,* cementum; *d,* dentin; *e,* pulp.

plished, the greater is the pressure necessarily exerted in the "time unit," and the less will there be normal stimuli through the exercise of function. The ratio of normal tension stresses to the pressure stresses is, therefore, less favorable, and consequently the structure of the bone differs more from the normal.

The third element is the *direction* of the force. Instead of forces acting mainly in the direction of the long axis of the tooth, the force of the appliance acts chiefly in a horizontal direction. Horizontal trabeculae are thus built, replacing the normal vertical trabeculae (Oppenheim). (Fig. 18.) As this bone is developed to furnish support against the pressure of the ap-

pliance, its structure is of little use in supporting the tooth in mastication, a factor which plays an important part in the problem of retention. During the action of the appliance pressure, there is, of course, a certain amount of normal stimulation provided by mastication. And again we see that the less favorable the ratio of appliance force to normal function, the greater is the

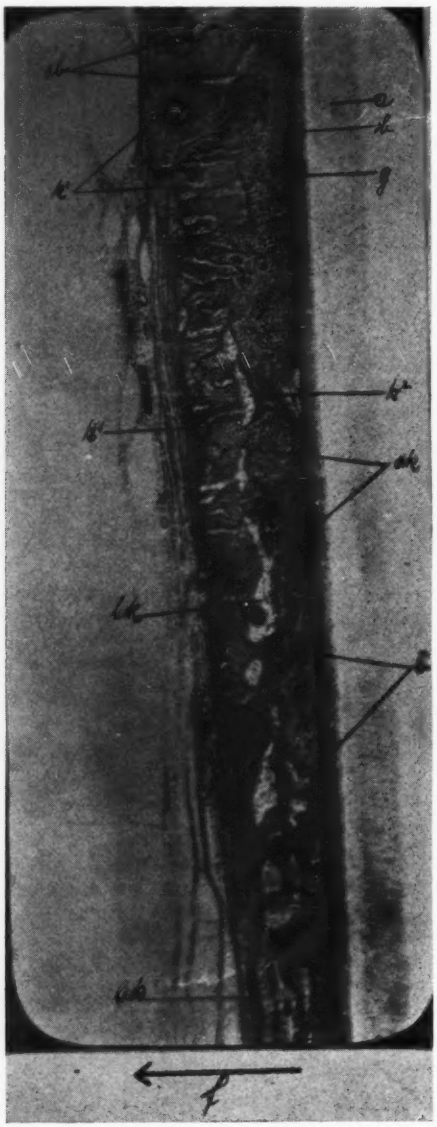


Fig. 18.—Alveolar process during treatment. Horizontal trabeculae are replacing the original vertical trabeculae. *a*, dentin; *b*, cementum; *g*, peridental membrane; *G*, blood vessels; *lk*, and k^2, old bone trabeculae in the direction of the long axis of the tooth; k^1, newly built trabeculae in the direction of the force (*f*); *ok*, osteoclasts; *ob*, osteoblasts. (Oppenheim.)

difference between the rearranged alveolar bone and the normal bone. This ratio is dependent upon the magnitude of appliance pressure and consequent rapidity of tooth movement. As it is the desire of the orthodontist to create a strong and healthy bone, the ideal movement seems to be an extremely slow movement under full function. These phases are represented in the

slow, physiologic mesial wandering of the teeth during life (Gottlieb). This movement is due to an intrinsic factor, the growth force of the jaws. No pressure bone is formed in this very slow movement, and the direction of the trabeculae is not changed. (Fig. 19.)

While those changes take place in the bone, the other parts of the unit are not unaffected by the treatment. Little is known about the conditions of the peridental membrane, but it is evident that the normal function of the fibers is disturbed. Instead of the stimuli of tension and suspension, there is compression on one side at least. On the other side, the fibers are not stretched in a direction parallel to the tooth axis, but perpendicular to it. And not only do they, by transmission of this force, create an abnormally arranged bone, but they themselves are abnormally stressed. To this con-

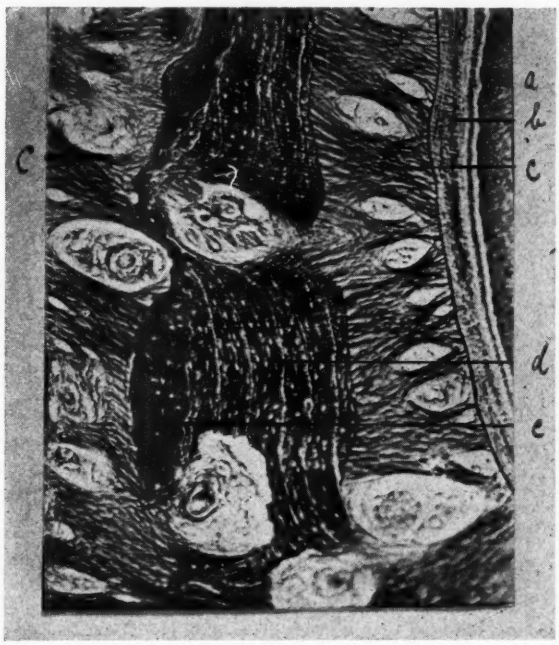


Fig. 19.—Alveolar process in physiologic wandering of teeth. The newly built bone (*d*) shows no signs of changes into a horizontal arrangement. *a*, dentin; *b*, cementum; *c*, fibers; *d*, new bone; *e*, old bone. (Gottlieb.)

dition is probably due the incidence of peridental diseases during tooth movement; and it may be regarded either as a predisposing factor, or conceivably as the exciting factor in the disease.

The abnormal loosening of teeth may be in part a manifestation of deranged conditions of the peridental fibers, and in part a disturbance of the other tissues of the unit.

In considering the cementum it must be repeated that physiologic function stimulates the continuous deposition of cementum layers, thus protecting the old layers against resorption. The orthodontic appliance is liable to disturb the deposition by impairing the functioning of the unit and thus depriving the cementum of its normal stimulation. This again is caused by the attachments which invariably restrict physiologic mobility of the tooth

in its alveolus and which will restrict it in direct proportion to the rigidity of the appliance. Besides this, there are two abnormal conditions produced through the appliance: first by using the root for anchorage, and second, by using the root as an instrument to produce bone absorption.

Anchorage.—We must recognize the fact that anchorage can always be measured by the size of the root surface involved. It has long been known that large rooted teeth offer more resistance than small rooted ones, regardless of the size of the crown. Furthermore, the resistance is less when the attachment permits tipping of the tooth than if it requires bodily movement, for the same reason that less cementum surface is engaged in tipping than in bodily movement. On the other hand, as the resistance and stability of anchorage increase, the physiologic mobility decreases. The tighter the attachment holds the tooth, the less can normal function produce its stimuli for cementum deposition.

Anchorage is defined as resistance against a force. This resistance is furnished by the peridental unit. But it must be remembered that this resistance implies something more than a merely passive function of the anchor tooth. When force is used to move a tooth, the pressure which is applied to this tooth is also felt with *equal intensity* on the anchor tooth, producing there an abnormal stimulation. The danger of root absorption is again dependent upon the ratio of those abnormal stresses created by the use of the tooth for anchorage, as compared to normal functional stresses. Without regard to these biologic factors, stationary anchorage is often used when simple anchorage would be sufficient, and it is sometimes rendered stationary in two directions, that is, prevents tipping in two directions, when it would be sufficient if it were made stationary in one direction only.

Bone Resorption.—The utilization of the cementum as an instrument to produce bone resorption is brought about through the application of pressure on the tooth. Here again it is an important matter whether tipping is allowed or bodily movement produced, and how much the attachment interferes with the mobility of the tooth. As another factor, there appears also the rapidity of the movement. A quick movement will, other conditions being equal, decrease normal stimulation in the "time unit" and so render the ratio less favorable. It also seems that the direction of the movement is not irrelevant. The forward wandering of teeth during the time of jaw growth, and also later on, is a fact that would suggest that forward movement in order to induce jaw growth is, in a certain way, a mechanical interference that the tissues may tolerate better than a posterior movement of teeth. This thought is a suggestion inviting observations of cases requiring more or less extensive posterior movement.

Root Absorption.—It has been shown that cases treated with rapid tooth movement and rigid appliances have a higher degree of root absorption (Ketcham). However, other factors also play a significant part. These factors are: the general nutrition, health, and endocrine influence. The cementum has an enormous power of regeneration. Examinations of teeth show root absorptions frequently followed by repairs. But repairs can only take

place if there is a normal cell metabolism and an abundance of building material. Regulation of diet (Hoffman), medication, such as cod-liver oil, orange juice, and the recommendation of exercise (Rogers, Robinson) are signs that the profession has recognized the importance of these factors. To their disturbance are due those cases of root absorptions which have been described (Simpson) as having occurred without orthodontic treatment.

Hypercementosis.—The occurrence of hypercementosis is another example of the regenerative power of the cementum. It is an endeavor of Nature, in conditions of abnormal stress, to enlarge the root surface, giving an area for the anchorage of a larger number of peridental fibers, and increasing thereby

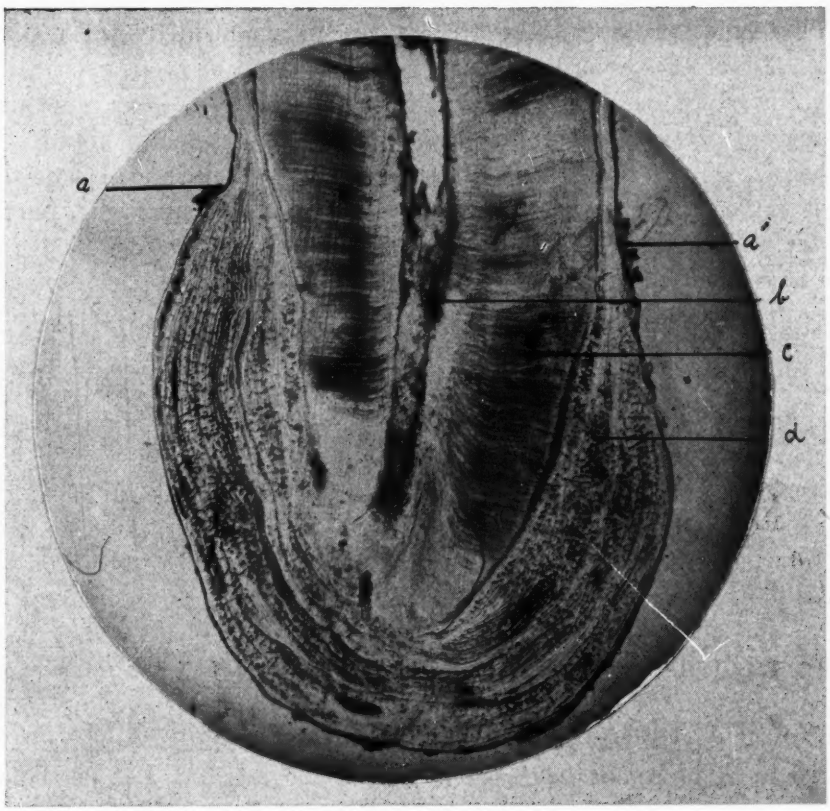


Fig. 20.*—Hypercementosis. Excessive deposition of cementum layers (*d*); *c*, dentin; *b*, pulp; *a*, *a'*, points of origin of hypercementosis.

the supporting power of the unit. (Fig. 20.) Strange as it may sound, there is a close relationship between hypercementosis and root absorption. The hypercementosis is virtually a hypertrophy of the cementum from heavy function, analogous to other organs which have the quality of compensating an unusually heavy function. They are built with a certain *safety factor* in order to allow accommodation to excess function. Hypercementosis is such a compensation. Also much of the so-called "condensing osteitis" of the bone is nothing but a compensation of such a type. It is by means of the heavy development of trabeculae that the stability is increased. But this com-

*The specimen for this slide was secured, through the courtesy of Dr. J. O. McCall, from the Periodontia Clinic of New York University, College of Dentistry.

pensating power of organs is limited. When the safety factor is exceeded, destruction of the tissues sets in. Atrophy follows hypertrophy. The same agency which—within certain limits—produces normal development, can, when it exceeds these limits, cause hypertrophy or atrophy. Most strikingly may this be observed in the case of the heart muscle in an insufficiency of the valves. Through the regurgitation of blood, the muscle has to sustain an excessive amount of labor and it hypertrophies. After the hypertrophy has reached its limit, the muscle breaks down.

The influence that function, when within normal limits, has upon the condition of the cementum, can also be seen in the frequency of root absorptions of anterior teeth. The incisors have for their function the incising of food. This function has in modern times been replaced by the use of knife and fork. Due to the cooking and other preparation of food, mastication as a whole is nowadays impaired, but no part of mastication is as much impaired as incising. Meat and vegetables are cut into small pieces, bread is broken off by hand. About the use use of the incisors which is still sanctioned by society is the eating of corn on the cob, and sometimes an apple, partaken of in privacy. Therefore, the incisors are our weakest teeth. They are susceptible to root absorptions, and they are liable to develop periodontal disease as the result of the slightest damage. Their roots do not tend to become thicker and longer as do those of the other teeth (McCall).

Summation.—In summation of the conditions involved in orthodontic treatment, we first have to consider the fact that function usually is impaired. Even the decreased amount of functional stresses acting upon the teeth cannot produce physiologic stimulation as the teeth are hindered in their mobility through attachments. It may further be said that the appliance forces acting upon the various tissues of the peridental unit are different from normal forces as to their type, causing pressure instead of tension, and as to their direction, acting chiefly horizontally instead of parallel to the tooth axis. The influence of those stimuli upon the various parts of the unit has been described. But there is another important difference which has to do with the element of *duration of the stimuli.* The value of continuous or intermittent force, and of rest periods has been discussed frequently. Let us see how the normal stimulations are distributed as to time and duration.

The act of mastication takes place a certain number of times each day, say three or four times. It extends over a certain period of time, say thirty minutes. After each period of exercise, there is a longer period of rest in which stimulation is maintained only by the factors of occlusal contact, speech, deglutition, and facial expression. Furthermore, each masticating action, each closing of the jaws for the purpose of biting or crushing food, has a characteristic feature; at the beginning of the stroke the pressure (conveyed to the unit as tension) is moderate, then gradually increases in intensity, and finally, toward the end of the stroke, decreases in force. This entire process is the only adequate stimulus for the unit, and nothing else can produce normal development.

The force exerted by the appliance differs materially from this; there is no moment of intense application and subsequent relaxation, and there is

also not the element of periods of exercise and rest. However, the most desirable appliance force, as considered by present standards, is continuous. When intermittent, there is such a difference between this intermittence and the intermittence in the act of mastication that it seems only to disturb the action of cells which have been mobilized for a certain purpose. The value of rest periods will be considered under retention.

While stating this difference as regards the time and duration element, it may be well to remember the fact that training of muscles can be produced only by systemic methods. Correct exercising is carried out by gradual innervation, intense effort, and subsequent relaxation; periods of exercise must be followed by intervals of rest. Continuous exercise does not strengthen the muscles, but weakens them and causes atrophy. Taylor's system has shown many such cases. The intermittence of stimulation, on the other hand, if applied in certain proportions, may even produce an increased resistance of the tissues against the force, instead of a metabolism toward their change, which is desired. This experience has been encountered frequently by surgeons in their treatment of faulty bone conditions, and sometimes by orthodontists in the intermittent wearing of intermaxillary elastics or extraoral anchorage.

As so little can be done to simulate physiologic force by appliance force, the greatest benefit apparently is derived if the appliance allows normal function and stimulation as freely as possible. This is accomplished by attachments which will permit the physiologic mobility of the tooth, the moving up and down of the tooth in its socket, the stretching of the fibers, and the functioning of the unit. No reference is made to types of appliances, as it is evident that their action depends largely upon the operator, and one operator may make finer adjustments with a rigid appliance than another with a light one. And after all, it depends entirely upon this adjustment, whether the ratio between appliance stimulation and normal stimulation is favorable or unfavorable. An effort to better this ratio by the increase of normal stimulation, through increase of function, is found in the method of having the patient chew on a rubber dumb-bell. (Ferris.)

RETENTION

The period of retention is characterized by the discontinuance of appliance forces. The teeth are subjected, as nearly as possible, to normal function in order to strengthen the supporting tissues to such a degree that they may keep the tooth in its new position. Orthodontists have found long ago that teeth may relapse if not retained, which is nothing but the clinical manifestation of the histologic fact that the bone around the tooth after movement is not of normal structure and therefore does not afford adequate support.

The bone at the beginning of the retaining period has, of course, the same structure as it had during treatment; namely, it is a pressure bone and the trabeculae are arranged in a horizontal direction. Under the influence of the now increasing normal stimulation, the horizontal trabeculae are gradually

being replaced and transformed into normal parallel structures (Oppenheim). (Fig. 21.) When this rearrangement is completed the period of retention is over. This statement implies that the time which is required for retention is largely dependent upon the conditions present at the end of the treatment. If in the ratio of appliance force to physiologic stimulation, the balance is strongly in favor of the appliance, then the horizontal arrangement, created under its influence, will greatly outweigh the parallel structures. If on the other hand, more normal stimulation is produced than appliance pressure, there will be a more nearly normal arrangement of the bone, and transformation will require less time.

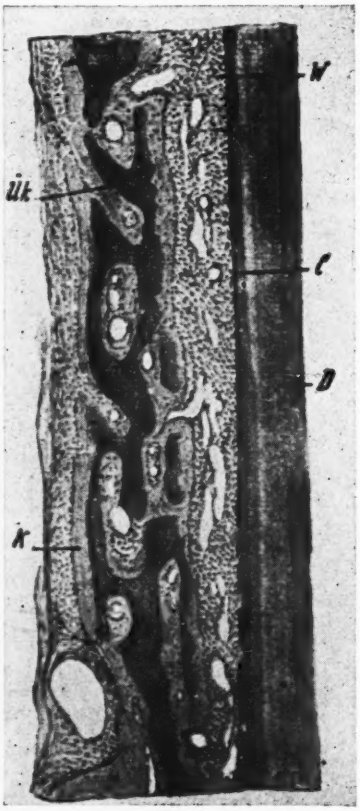


Fig. 21.—Alveolar process during retention. Horizontally arranged bone trabeculae (*Uk*) are being replaced by normal parallel bone trabeculae (*K*). *W*, peridental membrane; *C*, cementum; *D*, dentin. (Oppenheim.)

It must be understood, however, that normal forces of occlusion must have been established in order to develop a normal bone. If any one of the forces was allowed to remain abnormal, its influence would under abnormal stimulation, according to mechanical laws, develop an abnormal structure of the bone. For this most plastic material reacts to the slightest stimulation and changes its structure accordingly. As long as the retaining appliance is present, the influence of such forces may not be perceptible; but it will be manifest when the appliance is removed.

Clinical experience shows that the more rapid the movement and the more rigid the appliance, the longer the period of retention. On the other

hand, the shortest period of retention is made possible by slow movement, and a light appliance which allows for normal stimulation. Under ideal conditions of treatment, no retention should be required; or, in other words, the retention should be included in the treatment. Rest periods are an endeavor to distribute the retention (physiologic stimulation) in small periods over the time of treatment.

The influence of the forces operating during retention upon the peridental membrane and cementum has not been studied sufficiently. Considering the fact that with the establishment of normal occlusion the forces are producing physiologic stimulation, it is to be expected that the whole unit will return to normality. For the cementum, this is probably the time when repair of slighter damage takes place.

In conclusion it may be said that the influence of orthodontic appliances on the tissues comprising the peridental unit consists of a number of stimuli. Those stimuli may be more or less different from normal stimuli, they may take rank anywhere between the physiologic and pathologic. The reaction —and this may guide us in our operation—is always commensurate with the stimulation. Structures are created by function and for function. The appliance introduces a new, an abnormal function, but a function nevertheless and the tissues of the peridental unit will respond to any function, normal or abnormal.

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DISCUSSION

Dr. Martin Dewey.—Mr. President and Members of the American Society of Orthodontists: You have just listened to a paper which contains a greater number of truths than you will probably be able to absorb from hearing it the first time.

One of the important things which I wish to impress upon you is the relation of research work to the practical orthodontic procedure. In the beginning of Dr. Neustadt's paper he called attention to the fact that the alveolar process and the body of the mandible were the same type of histologic structures. In other words, as has been shown by Dr. McMillan recently, the alveolar process is true bone. That is a fact which was not recognized by older histologists. Also the alveolar process, as was seen in some of Dr. Neustadt's slides, shows haversian systems. That is another fact which was not supposed to exist, as a result of investigation by old histologists.

Another practical application of a law which Dr. Neustadt stated is, as we have heard stated before, that bone is developed as a result of function. A great many orthodontists have been biologists when they talked and not biologists when they practiced. What I mean by that is, we have recognized for a long time that bone development was the result of function. Then in a little while we hear the same men say that the body of the mandible cannot be developed because it is not a part of the alveolar process. If one can change the function of any bone, he will influence and change the development of that bone. From the standpoint of research, in regard to what we know relative to the development of bone, the correction of a case of malocclusion is simply an attempt upon the part of the orthodontist to change the function of those malposed teeth; to change the malposed teeth into teeth that are functioning normally. When that change is produced, a normal development of the alveolar process is obtained as well as the development of all the osseous structures associated with those teeth or, as Dr. Neustadt termed it, the peridental unit.

It has long been recognized by biologists and embryologists that certain cells develop as a result of certain organizers. If you will take, for example, an amphibian or frog, when it begins to develop right after fertilization, the egg passes through a process of segmentation. For a period of time all of those cells forming the fertilized frog egg are the same; they have not been differentiated. You will find very soon that certain cells begin to assume a certain polarity and drift toward a certain pole of the frog's egg, the egg splits or is segmented in different directions, and anterior and posterior polarity becomes established. Even at this time the cells seem to be the same. Very shortly there will develop a lipfold of that amphibian in which those cells are not as yet differentiated, and if some of those cells are transferred from the lipfold to some other part of the body, they lose their identity.

A little later they become organized to the extent that if they are transferred to some other part of the body, they exist as cells from the lipfold and proceed to multiply as such cells; this can be demonstrated by their coloring. They not only multiply, but they influence other cells to take on the same function.

As a result of that, biologists have called certain cells secondary organizers; the tooth is a secondary organizer as regards the developing structure, the peridental membrane, and the alveolar process. The tooth developing from epithelial cells begins development, and the mesoblastic structures supporting it begin to develop.

Besides these secondary organizers, of which the tooth is an example, it will be found that in certain cases other cells develop to the point where they are described by biologists as being organizers of the third type, an example of which is the balancer that develops in the salamander. Every salamander develops a balancer to enable him to swim upright. This balancer, which develops in the region of the branchial arches, is supplied from the mandibular nerve. The balancer develops first, after which the nerve is supplied to it. The balancer becomes an organizer for the development of that nerve, which is prompted by the fact that if the balancer, after it begins to develop, be transferred to another part of the salamander—some place in the posterior extremities for instance—the balancer continues to develop as a balancer because the cells have become specialized. And, lo and behold, the balancer is supplied by another nerve trunk, with a nerve that was never supposed to serve this purpose, all of which has its bearing from the standpoint of practical application.

A regulating appliance, from a biologic standpoint, is an organizer of the third class. By supplying a certain mechanical stimulation to simulate function as near as possible, a development is created which for some reason or another has been lacking. If normal function is established through the judicious use of regulating appliances, these bone changes go on and assume perfect histologic and physiologic aspects, and the change will occur in places far removed from where the pressure is applied.

It is incorrect to speak of pressure, which is a misnomer, because, as Dr. Neustadt has explained, a tooth is not supported by pressure but by suspension; that is, a tooth is held by the fibers of the peridental membrane and the bone develops as a result of the pull from those fibers through the attachment of the cementum and the alveolar process. As a result of that function the force is transmitted from the tooth to the peridental membrane and into the osseous structure where it produces changes in, what Lundstrom called, the apical base. This is rather an unfortunate misnomer, because the deficiency in the apical base, as Dr. Neustadt said, is a deficiency of development which can very often be increased, absolutely controlled, and reduced to normality by establishing normal function.

Therefore, from a practical application of these research investigations, if bone develops as a result of mechanical stimulation, our problem is to use an appliance which will be similar to Nature's function. As Dr. Neustadt said, the tooth must be free to move and respond to function, and any regulating appliance that interferes with the masticating function is going to interfere with normal development. Furthermore, after the regulating appliance has been used for the purpose of creating cell metabolism, this cell metabolism in normal growth should occur, normal function should be established, and a retaining appliance should be unnecessary.

The use of the retaining appliance from an orthodontic standpoint, as interpreted in the laws of biology, is an indication that normal function has not been established; something is still wrong. As I said before, there are so many points in this paper, that it is impossible for me to enumerate or call your attention to all of them, but the great thing back of it is that bone develops as a result of function.

Function from a regulating appliance is only in the form of mechanical stimulation which, interpreted in the terms of biology, should be considered as a third type of organizer, so used as to produce normal and physiologic growth. (Applause.)

Dr. Fred R. Blumenthal.—May I ask a point of information of Dr. Neustadt on his most interesting paper? Do I understand that faulty occlusion might cause the absorption of the apical third, or part of the apical third of the root ends, and if normal function be again restored, we might restore or regenerate the peridental membrane or the cementum of the dentin of the root?

Dr. Neustadt.—As far as faulty occlusion causing root absorption is concerned, there are many reasons why the root may be absorbed. The physiologic mobility may be hindered by different forces. One of them, as I have pointed out, is the appliance, and when the appliance interferes with function there will be root absorption. There are a great number of other pathologic factors which can produce root absorption. One of them may be faulty occlusion.

When you recall what Dr. Hellman said about the teeth in the skull of the monkey in which the teeth fell out of the alveolus when the mandible was turned upside down, you can see there was something wrong with the mastication of that monkey. The alveolus was very wide and the cementum thin. That is the reason the teeth fell out; the bone and the cementum were not developed properly. There was a cessation of development of the root, or there was what we call root resorption. Usually the cementum only is absorbed in these cases, and only in the later phase of the process is the dentin actually resorbed.

Coming nearer to Dr. Blumenthal's question, if there is faulty occlusion in the way of nonocclusion, and there is not enough normal function, due to the malposition of the tooth, root absorption will be likely to occur.

Dr. Blumenthal.—I would like to know whether or not the doctor believes that regeneration of the dentin and cementum may be obtained if the cause or effect has been removed.

Dr. Neustadt.—Regeneration of the dentin on its outer surface is impossible as far as our histologic knowledge goes. We could find regeneration of dentin in the pulp canal, but there is no possibility of regeneration either of dentin or of enamel on their outer surface as far as we know now. There is, however, a possibility of regeneration of cementum in a very large degree. Hardly any structure of the body has such possibilities of regeneration as bone and cementum which are closely related to each other. If the destruction has not gone too far and has not destroyed the vitality of the remaining connective tissue, there is very often a decided regeneration.

Dr. Blumenthal.—The doctor might enlighten us on the problem on which Dr. Ketcham and several others have been working for some time. Dr. Ketcham showed a typical case yesterday, and I have some in my own practice, where the canine tooth has come down in contact with the lateral incisor and has caused a complete absorption or partial absorption, if we may use the word, of the upper third at least. I would like to ask Dr. Neustadt if, after getting the canine tooth into alignment, as Dr. Ketcham has done—by the way, we must remember the cases reported were such that the lateral tooth, although absorbed, probably a third or more was still vital—he believes there may ever be regeneration of that root.

In view of the facts that all the pressure has been alleviated, and normal occlusion, or as near normal as we are able to obtain without pressure, has been made effective, will the absorption of that root continue?

Dr. Neustadt.—I know the case to which Dr. Blumenthal refers, and it is my firm belief that the lateral incisor will regenerate. Remembering the fact that one part of this root has been resorbed, it will be seen that the root surface now is smaller than the root surface was before resorption of this apical third. The functional stimuli applied to the root surface will be distributed on the smaller surface. This will, provided the stress is not too great, constitute a very good condition for regeneration. I think this tooth will show hypercementosis in a very short time, when all the causative factors of resorption have been removed.

There is one factor to which I must refer in talking about regeneration, and that is the systemic condition. It is because of variations in this condition that root absorption is found in some cases and not in others. In some cases there is a low resistance, and in these cases even careful treatment will disturb the deposition of cement; or there is deficient nutrition and not enough material for the growth of the cementum. If there is a high resistance and good nutrition, all the factors are present and all the material which is necessary for the

deposition of cementum. These cases may be treated with rigid appliances, and they will not show root absorption. This is a factor that should be taken into consideration in the study of absorption and regeneration.

Dr. Blumenthal.—I want to thank Dr. Neustadt for his explanation. Dr. Ketcham and I shall be glad to watch the regeneration of the roots which will occur.

In closing I might say that, in working along these lines for years, the laying down of the cement layers, as he has just added, can be done for exhibition work in periods of not more than weeks at a time by just the diet. I want to thank you very much. (Applause.)

Dr. Henry C. Ferris.—I shall refer to the rubber dumb-bell which I use in my practice. Function has been proved to you, during this whole session, to be the most vital consideration in the control of the health of the bone. I use a little rubber rope and have my patients, or the mothers, direct mastication upon it twenty times on each tooth before each meal, whether the appliance is upon the tooth or not. I tell the mother that this exercise saves both time and money; I get excellent results.

Science has been proved to be in favor of my recommendation, and my personal practical experience has favored it for the last ten years. I commend it to you. In handling adult cases it will be found possible to get along without pain or discomfort or nerve irritation by systematic use of this method, and some uncertainties about retention will be reduced. (Applause.)

Dr. Albert H. Ketcham.—Mr. President, I am greatly interested in this excellent paper and its discussion. The point of nutrition, I think, should be stressed.

A little over a year ago, in San Francisco, I visited the Hooper Institute for Scientific Research with which Dr. F. V. Simonton and his assistant, Dr. Martha Jones, are connected. They are carrying on investigations in regard to the effect which changes in diet have upon the dental tissues. For these experiments they are using some of the lower animals and also a group of men. I saw the picture of a mandibular canine from one of the dogs, in which on a restricted diet there had been a loss of, we shall say, the apical of one-fourth of the root of the tooth. Then with a change of diet there had been a redeposition of a substance less dense than the tooth root, building the tooth out to nearly its original form and size.

It would seem that the underlying cause of these cases of resorption is faulty calcification of bones and the roots of teeth. Upon this faulty structure we use appliances, and we often have resorption of the tooth roots. With the very same treatment upon properly calcified teeth, we do not have resorptions. I shall just leave this with you to think about. (Applause.)

Dr. Neustadt.—In answer to the discussion by Dr. Ferris, I wish to say that I know his plan of treatment, and I very much approve of it. When the appliance is on it will keep the tooth, to a certain degree, from functioning the way it did function before, but function can be improved by increase of mastication or exercise.

I want to express my gratitude to Dr. Martin Dewey for providing facilities for this research work and for cooperating with me on all points of histology, pathology, and orthodontia. I also want to thank your President, Dr. Eby, for his interest. (Applause.)

A CRITIQUE OF SIMON'S DIAGNOSTIC METHODS*

By Frederick Lester Stanton, D.D.S., New York City
Professor of Preventive Dentistry, New York University College of Dentistry

IN ORDER properly to evaluate Simon's methods, it is necessary to split up his writings and orient the parts into the fields from which they have been derived.

1. Philosophy
2. Anthropometry
3. Analytical geometry
4. Photography

The main part of this paper will deal with divisions 2 and 3.

Simon proposes to construct a model of a denture, the lower base of which is parallel to the Frankfort plane and whose upper base is the Frankfort plane.

As he wishes to use a three-plane system, it is necessary for him to select two vertical planes at right angles and add them at right angles to his horizontal plane—(Frankfort plane, or XY plane).

In establishing his Frankfort plane on the ear and eye points, he is able to scratch a line on his model which is a projection of the line connecting the two eye points.

He proposed as his second plane (the usual XZ plane) the orbital plane, i.e., a vertical plane at right angles to the Frankfort plane passing through the two orbital points of the Frankfort plane. Instead of proceeding to mark this plane on his model, he simply projects a line 5 mm. on the impression material of the upper jaw. Later this mark appears on the upper cast. No attempt has been made to preserve the interrelation of the orbital or ear points. At this stage there is a model with rough sides and smooth bases, the upper base representing the Frankfort plane and a 5 mm. mark of the palate of the upper cast a projection of the orbital plane. Simon now proceeds to select his third plane (YZ plane) the sagittal plane.

Two points are selected by eye (depending upon the judgment of the operator) on the median raphe marked by pencil dots; with a suitable instrument the projection of the sagittal plane is scratched on both models, and the back of the *models are trimmed* at right angles to the sagittal plane.

The upper model is now rotated 90 degrees and the 5 mm. projection of the orbital plane is brought beneath the marker and a line is scratched about both models at right angles to the sagittal plane, which Simon calls the orbital plane.

*Read at the Twenty-sixth Annual Meeting of the American Society of Orthodontists, Chicago, May 2, 1927.

If the selected sagittal plane is not at right angles to the projection of the orbital plane, Simon proceeds to use but one point of the true orbital plane (presumably the point that is on the sagittal line) and scratches his new orbital plane on the model. This line is at right angles to the sagittal plane and may touch but one point on the orbital plane projection.

This method of selecting the three planes seems to be in error. For no system of measurement, in a three-plane system of coordinates, should contain a plan of determining the directions of two planes that rest on the judgment of the observer, such as the selection of the two points on the median raphe which control the direction of two planes (sagittal and orbital).

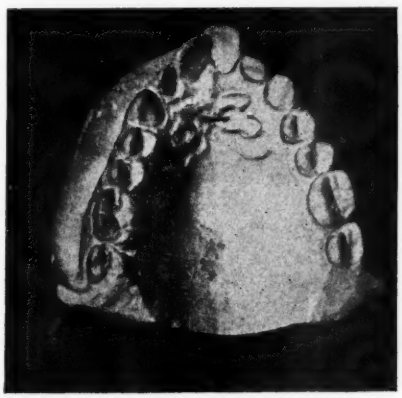


Fig. 1.

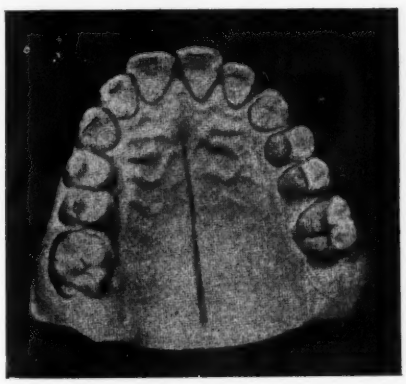


Fig. 2.

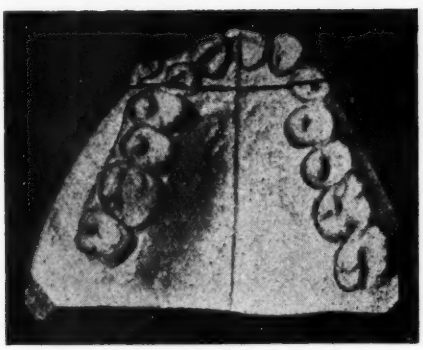


Fig. 3.

This mistake is further magnified, for in addition to the error that might arise from different observers selecting different raphe points, there is to be added the fact that Simon is wrong in assuming that the median raphe can be used as the sagittal plane of the head even in normal skulls. As a basis of diagnosis in severe cases of malocclusion this assumption would lead to grave errors of diagnosis, as in these cases the raphe follows a most erratic course.

To illustrate:

Percy Howe used the two monkeys illustrated for an experiment to show the effect of deficient diet on the growth of the skull. The animal on the

right, Fig. 4, was given a normal diet, the one on the left, a deficient diet. The deformed animal lived a few days longer than the control.

Fig. 7 shows orthographic projections of the two skulls projected to the Frankfort plane. You will note that the raphe of the normal skull does not follow a straight line. The plane of the ear points cuts the foramen magnum near its anterior margin and the orbital plane falls between the temporary molars. In the deformed skull on the right, the ear plane preserves its correct relation with the foramen magnum, while the orbital plane shows the deformity has affected the symmetrical development in the orbital region.

Fig. 4.

Fig. 5.

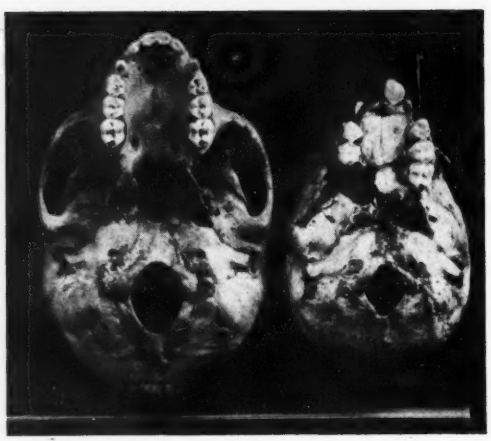


Fig. 6.

In Fig. 8 you have the two skulls related by registering the two ear planes on a point midway between the two ear points on each map. It is obvious that if two points had been selected by eye on the raphe, many different axes might have been selected that would hardly have yielded as good results as the method used. It is to be regretted that Simon made no projections to the Frankfort plane either of the denture or raphe.

The axis shown on the normal skull (Fig. 7) was computed by my method of considering the denture, without reference to the head, finding a centroid of the denture, and finding the axis by the theory of least squares.*

*Arch Predetermination, etc., International Journal of Orthodontia, December, 1922.

Note how nearly this engineering axis passes through the center of the foramen magnum shown as 1.

A model of malocclusion is shown in Figs. 9, 10, 11 and 12. It presents no unusual features and was selected to test on the drawing board Simon's selection of his three planes. In order to relate the malocclusion to the eye ear points, an upper plaster impression was made with the Schwartz apparatus as shown in Fig. 13. This apparatus was mounted on a precise measuring instrument leveled on the eye ear points (Frankfort Plane). The eye ear points were orthographically projected, eye points at O, ear points at E. The median raphe was projected and several cusp points. The elevations of all points were recorded. We then added to the drawing an orthographic map of complete malocclusion surveyed from the model (Fig. 14).

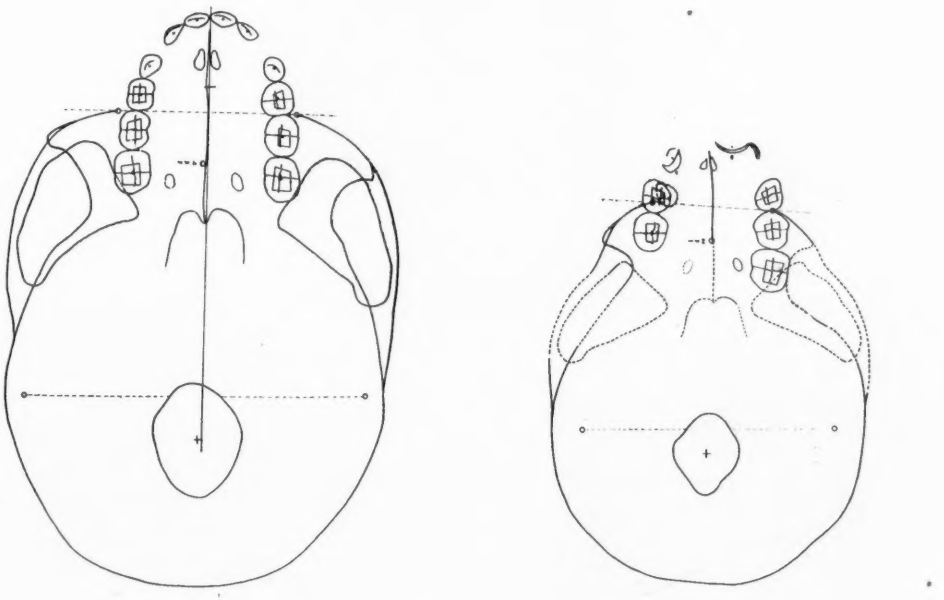


Fig. 7.

Selecting two points on the median raphe according to Simon's plan, we then drew Simon's second plane, the median sagittal plane as S. Simon selects his third plane by scratching, on the model, a line at right angles to the sagittal plane at the point common to sagittal and orbital plane as scratched on model. We, therefore, do the same on the drawing board and Simon's third plane (orbital) appears at O′ O′.

The next figure (15) is the same as the previous illustration, with the addition of two axes. Axis H is the line connecting the bisections of the ear and eye point lines (OO and EE).

The axis A is our axis of symmetry computed without considering any head points other than the teeth. The centroid X is first computed and then by the application of an engineering formula previously reported, the axis A is drawn.*

*See footnote, p. 28.

The next map (Fig. 16) shows the teeth of this case arranged in normal occlusion on the nearest arch form to the malocclusion. The orbital plane is drawn through the cusps of the canines.

We next proceed to relate the normal map to the map of malocclusion. Simon's orbital plane is registered on orbital plane of normal map. Simon's sagittal plane is registered with sagittal plane of normal map and two com-

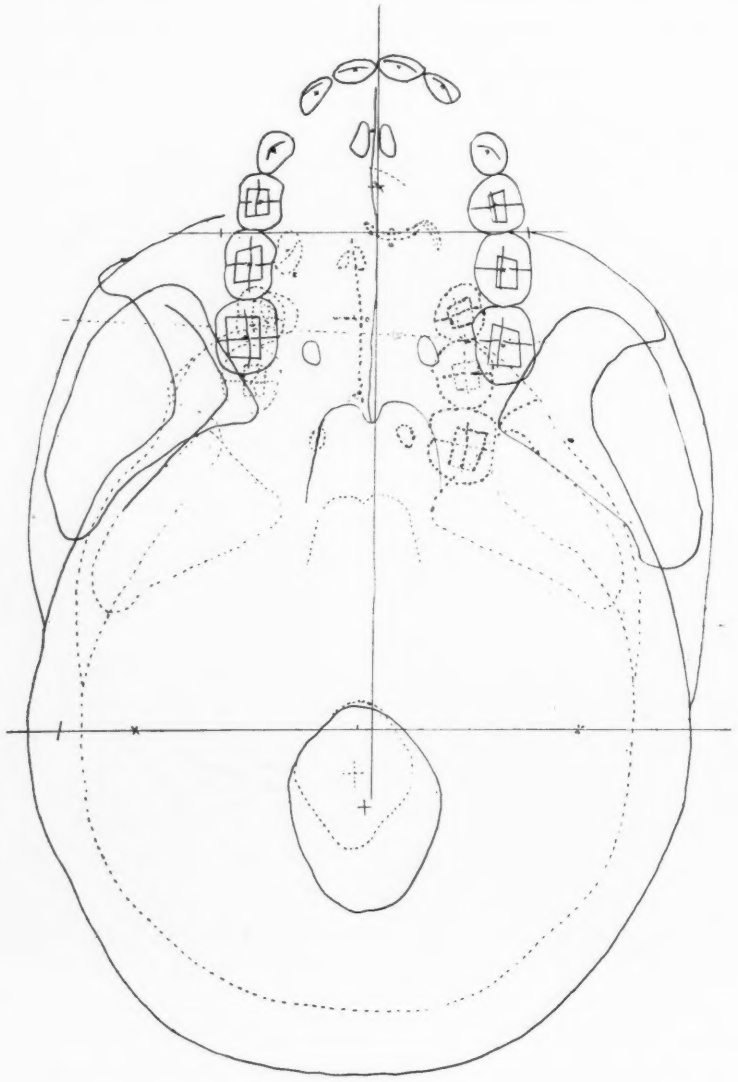


Fig. 8.

posite maps are drawn showing the amount and direction of tooth movement required in order to carry out the Simon's diagnosis. (Figs. 17 and 18.)

Maps, Figs. 19 and 20, will show the proposed movements of upper and lower teeth. These maps are constructed by relating the occlusion map (Fig. 16) to malocclusion in such a manner that the sum of the squares of movement are a minimum. (Registration by means of denture centroids and axes of symmetry.)

Comparison of tooth movement between Simon's treatment and our own:

		UPPER		LOWER	
		Simon's	*Ours*	*Simon's*	*Ours*
Left	6	2.5	3.1	6.2	2.6
"	5	5.5	5.1	7.3	3.7
"	4	5.1	4.8	8.1	4.4
"	3	5.2	5.3	7.2	2.8
"	2	6.0	1.4	7.0	2.1
"	1	6.0	1.2	6.7	1.3
Right	1	6.7	.7	6.7	1.0
"	2	5.8	1.0	8.0	2.7
"	3	---	---	7.5	2.6
"	4	4.7	5.9	7.7	3.1
"	5	5.2	5.4	8.0	3.4
"	6	4.2	3.6	7.6	3.7
Totals		57.9	37.5	88.0	33.4

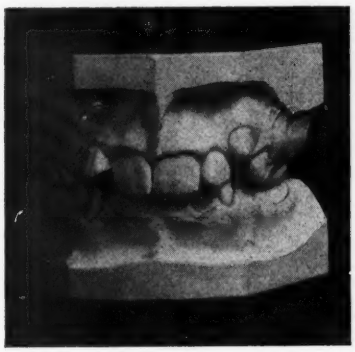


Fig. 9.

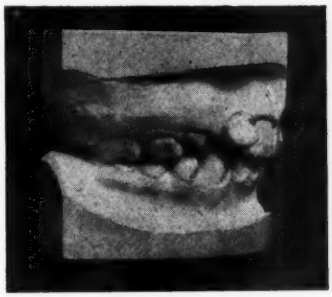


Fig. 10.

Fig. 11.

Under the Simon's plan the tooth movement would be 145.9 mm. On the theory of least squares, the movement would be 70.9 mm.

ELEVATIONS

Lingual gum line	E	258.5	E	257.8
Mesiobuccal cusp	6	252.9	6	245.8
Lingual gum line	1	252	1	252.5

Recorded elevations show that the denture is symmetrically placed with reference to the Frankfort plane, i.e., right and left corresponding points are equidistant from the Frankfort plane.

From the diagram (Fig. 15), it is seen that the eye and ear points present a very symmetrical arrangement which was totally destroyed by following Simon's method of selecting the sagittal plane by the median raphe and altering the orbital plane so as to make a right angle of the sagittal and orbital planes. If Simon had accepted the orbital plane, as measured, for his second plane and then recorded these points in relation to the denture as a

Fig. 12.

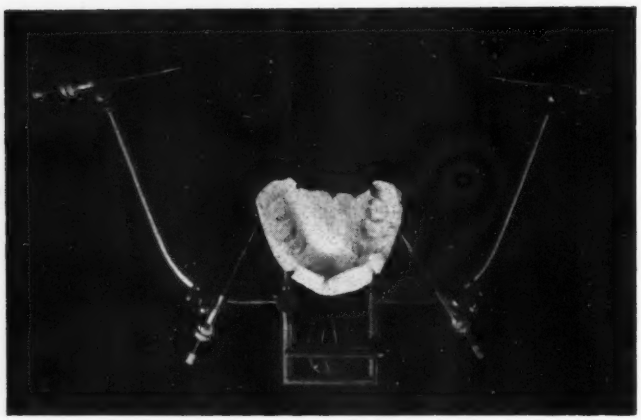


Fig. 13.—Schwartz apparatus, April, 1927.

whole, he could have selected a sagittal plane that would have been more satisfactory and he would further have protected his followers from the difficulty of selecting two points on the median raphe. There would have been the further advantage, the eye ear points would be less likely to be affected by the deformity of the jaws. In this event the direction of the sagittal plane would be fixed by the eye ear points; the only thing required would be to place this plane in its right and left position.

By referring to Fig. 15, it will be seen even with all this precise data, it would be difficult to select a satisfactory third plane, for the plane H symmetrical with the eye ear points is not the plane of symmetry for this denture and it is some 4 mm. from the median raphe.

The S axis is obviously wrong, not only in its angulation but it would move the whole denture further to the left in treatment. This brings us to the important lesson that may be drawn from the study of this case:

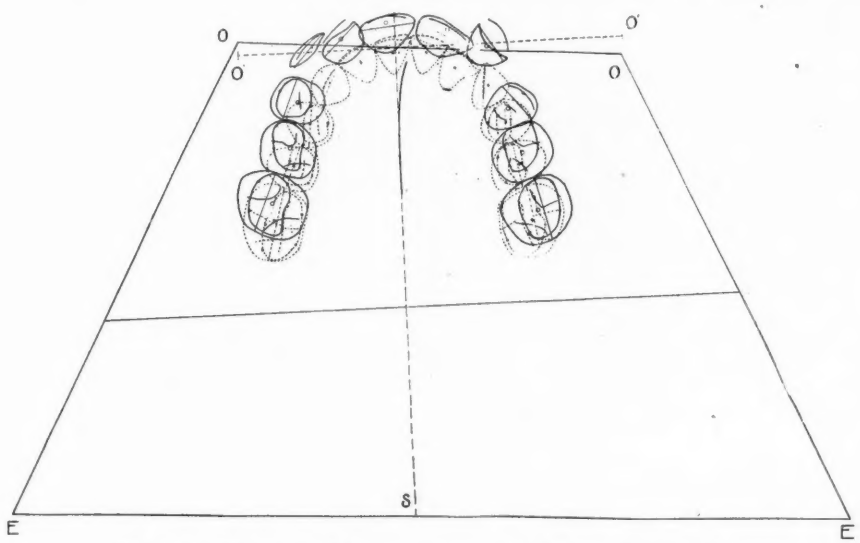


Fig. 14.—Upper and lower survey related to Simon axis.

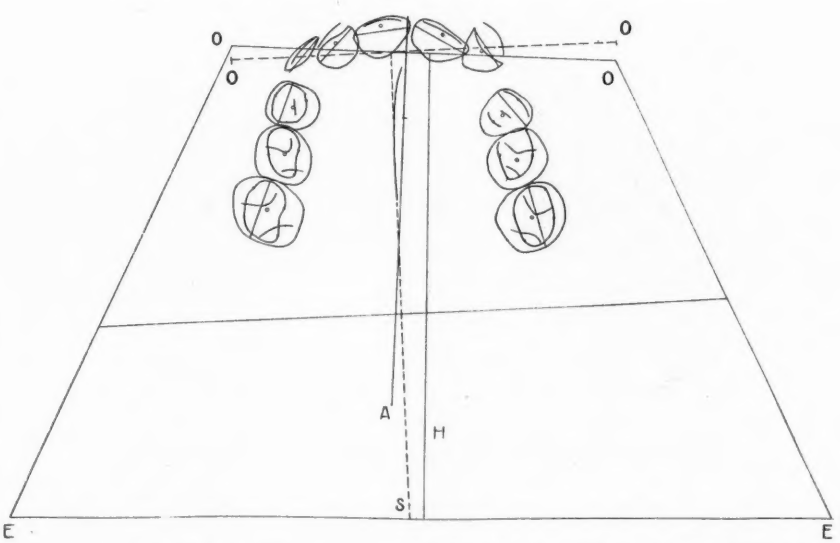


Fig. 15.—Upper survey related to Simon axis with F.L.S. axis and geometric axis of head. *A.*—F.L.S. axis; *S.* Simon axis; *H.* Geometric axis of head.

In cases of malocclusion the denture as a whole may be bodily displaced to the right or left (the same condition may be found in normal skulls to a lesser degree), therefore with our present knowledge of craniometry the safest diagnosis and treatment should be based *on the selection of curves in three dimensions that will produce normal occlusion for any given individual*

with the minimum tooth movement, as first outlined in a paper by the author and Rudolph Hanan, Panama-Pacific Congress, September, 1915.

Other examples follow to show the median raphe is a poor guide for the plane of symmetry for testing an abnormal denture.

Now let us examine Simon's method of diagnosis by using data obtained from his measurements. We will first consider the orbital plane diagnosis. Quoting—"The third plane is the so-called orbital plane * * * according to my judgment the most important to us * * *."

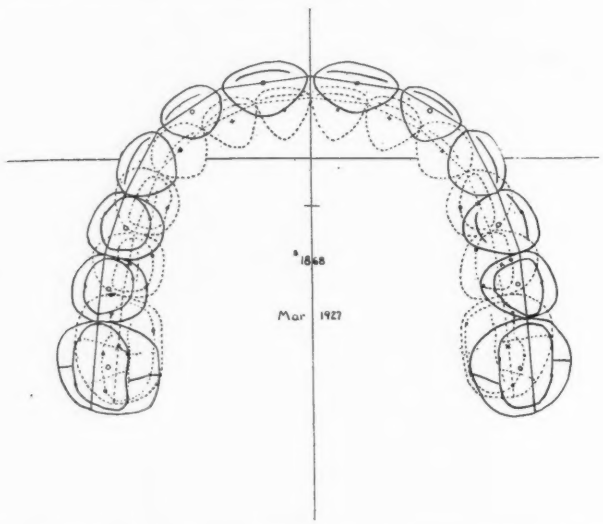


Fig. 16.—F.L.S. Occlusion related to Simon orbital plane.

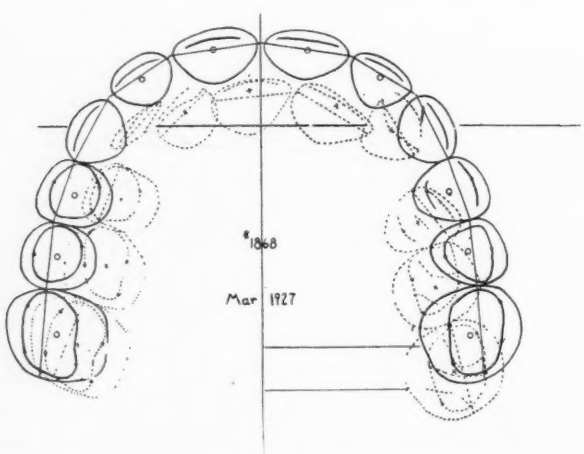


Fig. 17.—Upper treatment Simon occlusion.

"We collected several hundred cases of jaws with correct anatomical occlusion and examined them with a gnathostat. These jaws had all the teeth and all of them had their right contact and the right occlusion. It was observed that in most of these cases the orbital plane passed through the maxillary canines. *This is an incontestable truth* * * *."

Simon further bolsters his "Orbital Law of the Canine" by stating, "Under normal conditions the orbital plane intersects the denture in the

region of the canine; and it does this at any age—from five to forty years—in the temporary as well as the permanent teeth." Book 71 (Illus. Fig. 15 Reprint).

"The orbital law of the canine is only one, but it is the most important of a whole series of such rules that I found in the examination of a vast material." (Reprint, Page 12.)

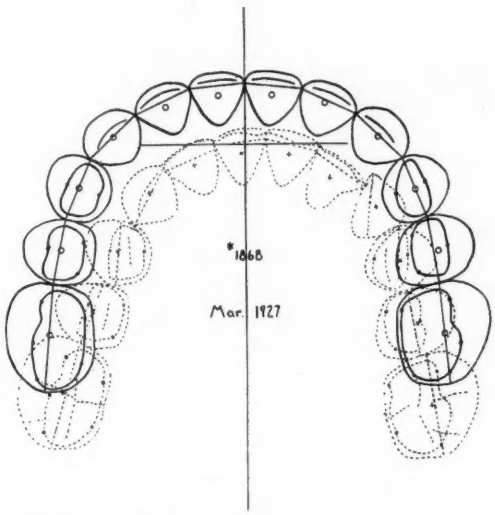


Fig. 18.—Lower treatment Simon occlusion.

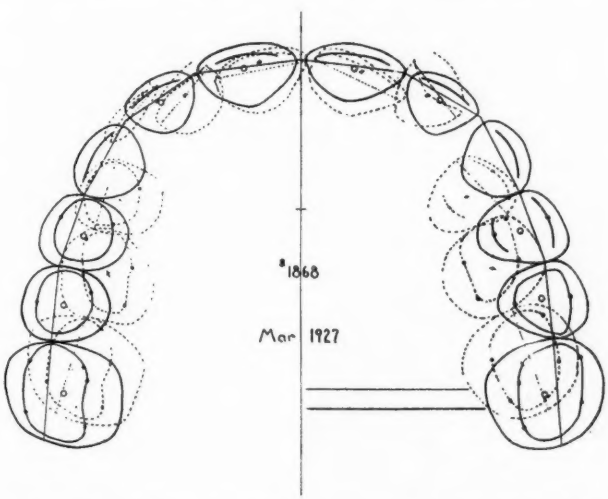


Fig. 19.—Upper treatment theory of least squares.

This will suffice to show how Simon evaluates his scientific "law of canine." Broadbent, working in the Research Department of the Western Reserve Medical School, under Wingate Todd, a recognized anthropologist, measured normal skulls and found in no instance did the orbital plane pass through the cusp of the canine. In normal skulls he found that it might pass through the parocone of M^1.

Broadbent's illustrations show the precision instruments used and his graphs are models to be followed by future research workers.

Wolfson, at the recent International Orthodontic Congress, reported his findings on the examination of skulls at the Museum of the American Indian, working under the direction of Oeterking, a capable anthropologist. Wolfson's findings parallel Broadbent's as he found normal skulls with the orbital plane passing through the front cusp of the first maxillary molar. Wolfson's range of normal variation was 18 mm. and Broadbent's 19 mm.

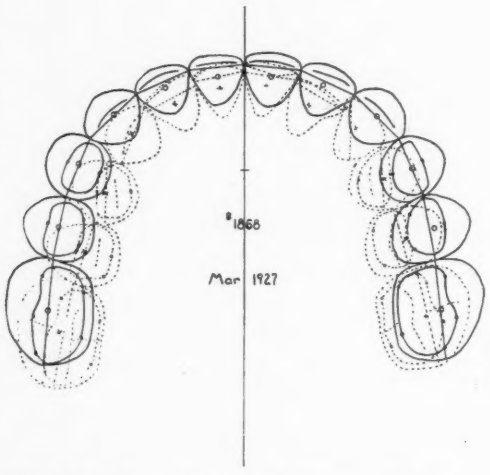


Fig. 20.—Lower treatment theory of least squares.

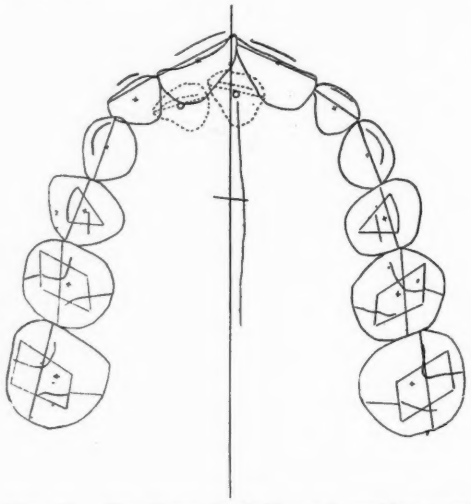


Fig. 21.—To show deviation of median raphe with axis of symmetry.

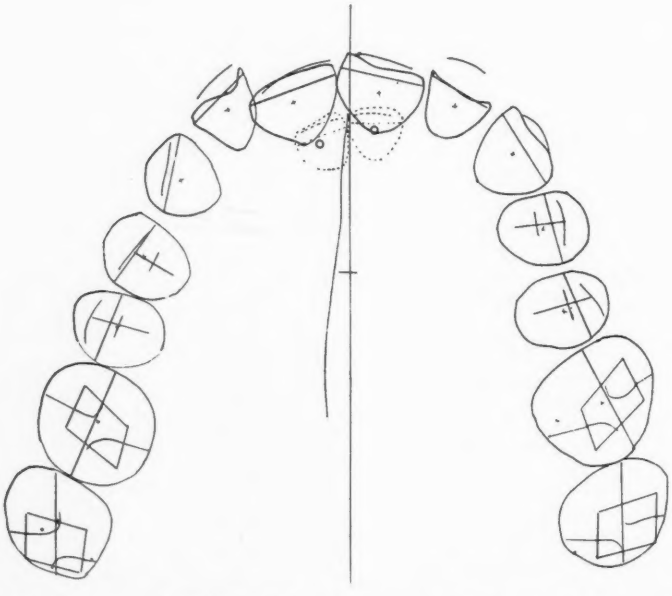


Fig. 22.—To show deviation of median raphe with axis of symmetry.

Okada of Tokyo projected a large number of skulls at the U. S. National Museum, using my pantographic surveyor, and obtained results similar to Wolfson and Broadbent. Okada's work has not been published so I simply show one map to prove his point. Okada is visiting the leading museums of the world, spending one year in the examination of normal skulls of all races. The information he is about to publish will cast further light on the

"law of the canine." He should not be open to the criticism usually hurled by Simon's followers at investigators, namely, that they did not measure German skulls, for Okada set out to measure Simon's material in Berlin.

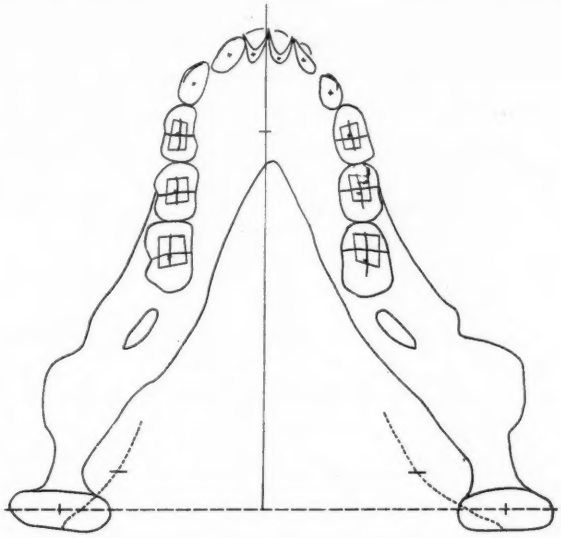


Fig. 23.—Normal mandible (monkey). Sagittal plane (axis of symmetry of denture) does not bisect line connecting condyles.

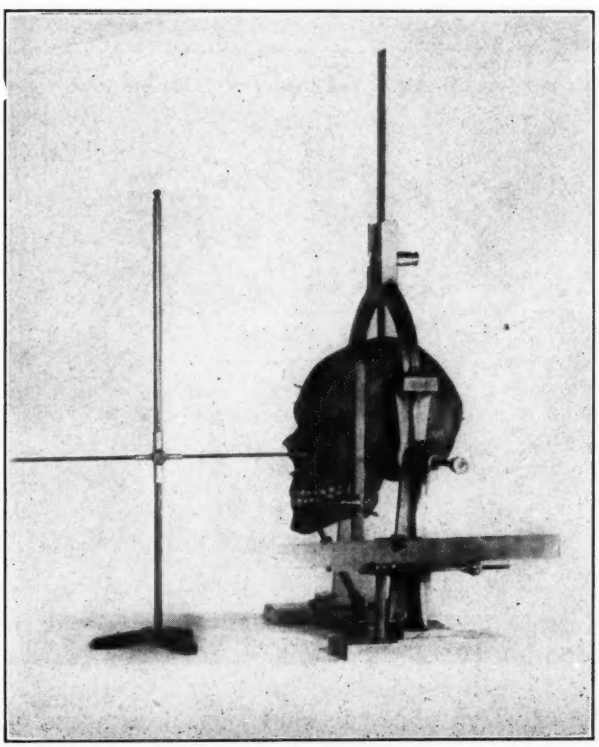


Fig. 24.—Instrument devised by Todd and used by Broadbent at Western Reserve Research Laboratory.

Hellman, research worker at the American Museum of Natural History, an authority on occlusal relations of the teeth in anthropologic circles, examined the "canine law" from a different slant. Hellman has access to a

large number of crania of all ages in a given race. Hellman measured the angle between a line drawn from the orbital point to the cusp of canine and the Frankfort plane. Starting with his youngest skull, he found that the angle was a constantly increasing one until full growth was obtained.

With this evidence of careful research workers before you, we will leave the "Orbital Law of the Canine" without comment.

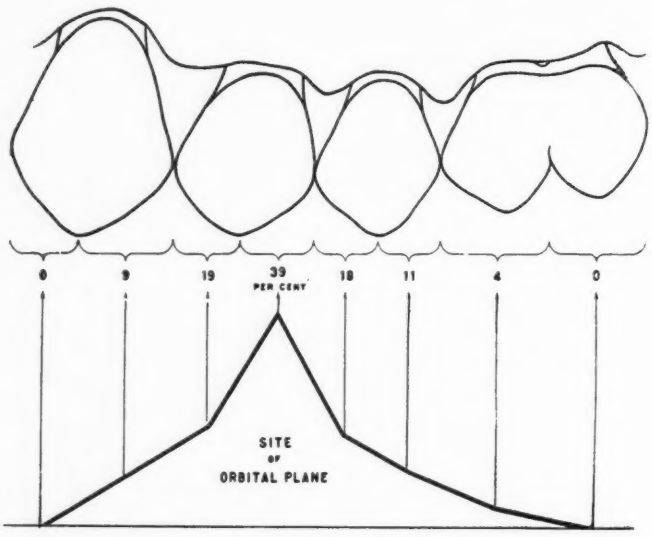


Fig. 25.—Seventy-five norms out of 800 specimens at Western Reserve charted by Broadbent.

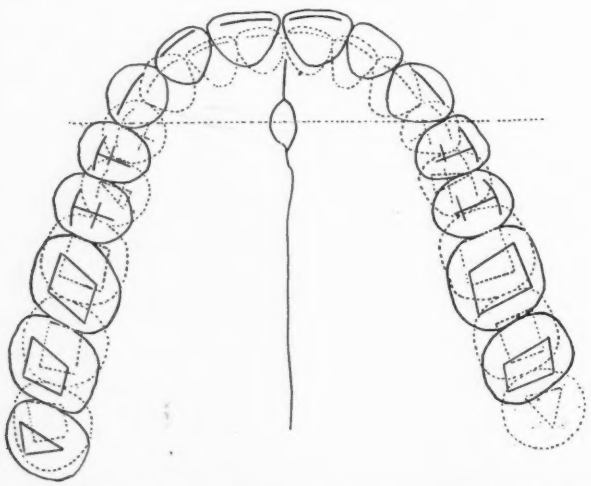


Fig. 26.—Skull surveyed at National Museum by Dr. Okada. Cross line orbital plane.

For the determination of the normal horizontal arch form of any case of malocclusion, Simon suggests the form may be found by using the Pon's table. This table is one of anthropologic averages and assumes that the arch of man has a correlation between the combined widths for the four maxillary incisors and the distance between the distal pits of the first premolars and the mesial pits of the first molars.

Example:

1. When the combined diameters of the incisors measure 25 mm.
2. The distance between 1st P.M. pits is 31 mm.
3. " " " 1st Molar " " 39 mm.

For every millimeter increase of the incisors, a corresponding increase must be made in arch width at premolar and molar points. In other words, *the form of the dental arch is always the same geometric figure varying only in size as the teeth vary in size.*

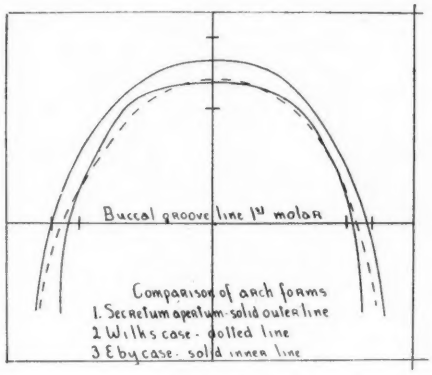

Buccal groove line 1st molar
Comparison of arch forms
1. Secretum apertum-solid outer line
2 Wilks case - dotted line
3 Ebycase - solid inner line

Fig. 27.

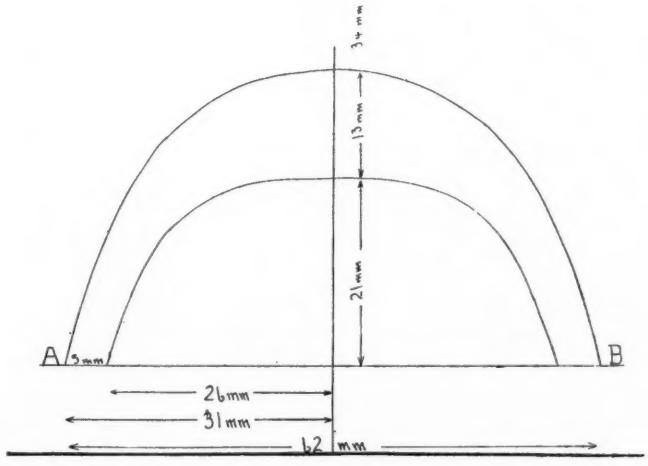


Fig. 28.

You will all agree that the head form varies in man.

The palate index $\frac{(W \times 100)}{(L)}$ varies between 90 and 115.

The same phenomenon is ever present in the dental arch.

Since 1915, the author has many times presented evidence on form and dimension of the normal dental arch and has suggested ways and means of finding the normal arch for any case of malocclusion, and a more important contribution, a method of relating the abnormal form to the normal by a theory of least squares to show the minimum movement required.

If normal dentures are projected to a plane, it will be found that curves of various characters may be drawn on the summits of the buccal cusps and

incisal edges. The forms will vary; some will be an arcs of ellipses (closed curves), parabola, cubic parobola (open curves) and other curves of unknown formulas. Some arches will be blunt and others of sharp curvature in the incisal region. Curves of normal arches if superimposed will cross and re-cross, showing there is no one form that can be used as a norm.

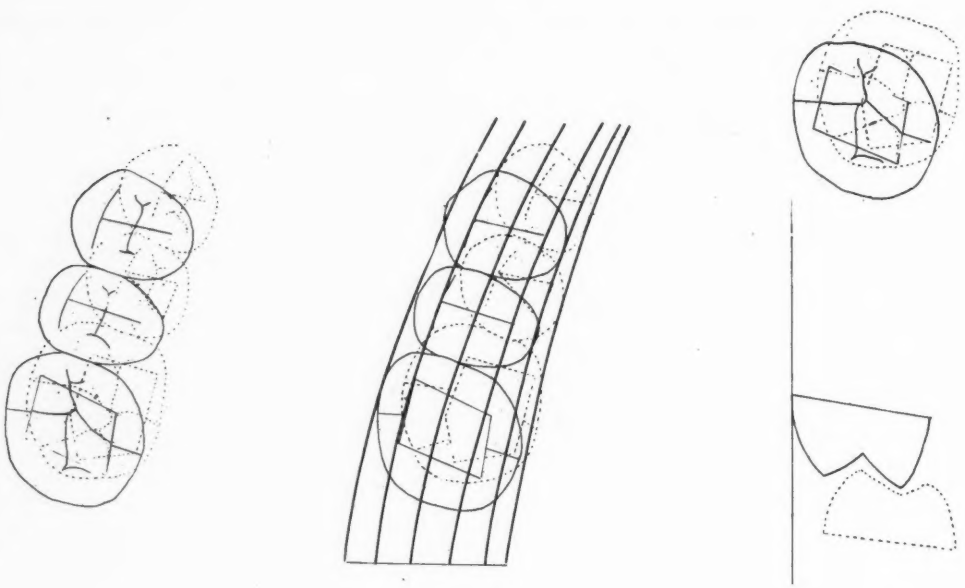


Fig. 29.

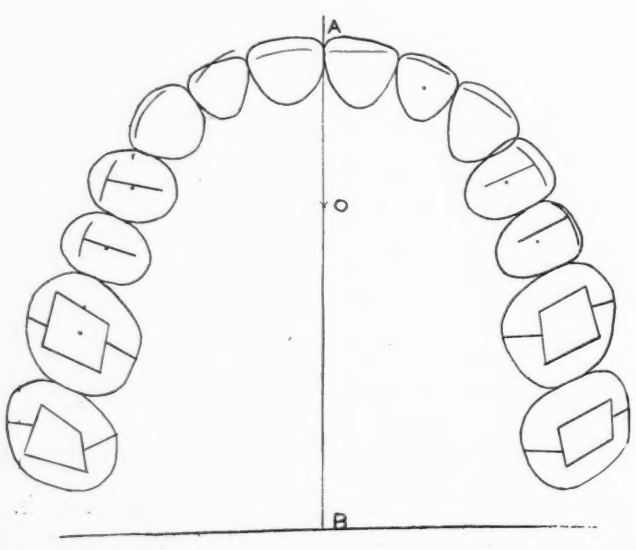


Fig. 30.—Eby case upper survey.

Fig. 28 illustrates why the arch form index varies like the cephalic and uranic indices and shows the result of superimposing curves of normal arches from several races. In the region of the first molar, all curves fell within a 5 mm. area, while in the incisal region there is a variation of 13 mm.

The accompanying map (Fig. 29) is of

A. Japanese with normal occlusion.

B. Occlusion of molars and premolars with curves drawn to show the interrelation of anatomic points of upper and lower teeth.

C. Shows cross section of molar (schematic) to further illustrate the precision with which teeth must be placed if normal occlusal relations are to be obtained.

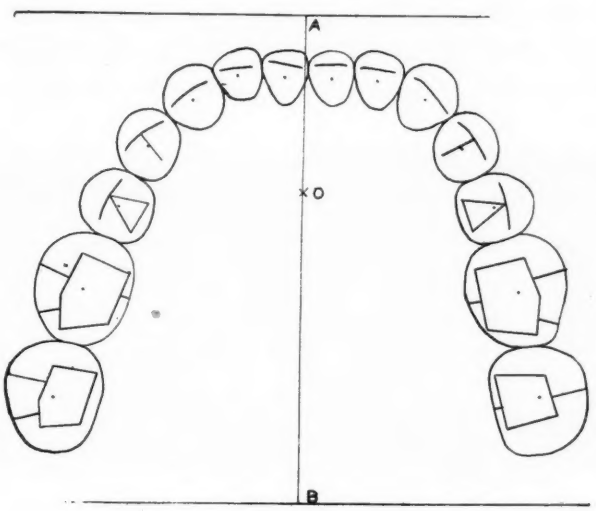


Fig. 31.—Eby case lower survey.

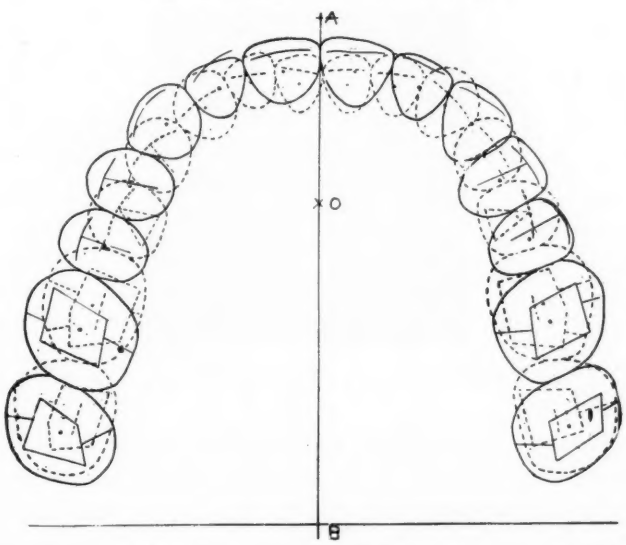


Fig. 32.—Eby case survey. Solid line, upper; dotted line, lower; *O*, denture centroid; *A.B.*, axis of symmetry.

In order to illustrate the fallacy of Simon's contention in regard to the use of the Pon's table:

The following nearly normal case is shown in three maps.

32 A—the upper.

33 B—the lower.

34 C—combined upper and lower.

From an examination of the model, it will be noted that the occlusal relations of the right cheek teeth are not as good as the left cheek teeth, and the left upper lateral incisor is rotated on two axes. From the maps it will be seen that the right upper second premolar is tipped cheekwise and the right lower canine is slightly out of the line of the arch.

We will now proceed to make a diagnosis of arch form in two ways:

First—by the Simon's method. (Pons' table.)

The four incisors measure 27.1 mm., consequently the premolars should be 33.6 mm. and the molar width 42.6 mm. We now construct a map of the upper, putting the premolar and molars on the Pon's measurement and then complete the upper map. We next fit the lower molars correctly with uppers,

Fig. 33.—Eby model occlusal view. Normal occlusion.

Fig. 34.—Eby model right side.

then the premolars and canines and we now find it impossible to get the lower incisors in a smooth curve, so we have drawn them bunched. If we had started with the lower incisors and placed them on a smooth curve, we would have had distal occlusion of the molars.

We now construct an occlusal map for this case, correcting all abnormalities and, with a proper technic, we find there is no trouble to place all of the teeth in normal occlusion.

For comparison, we relate the two predetermined arches to the map of the model to see the relative changes required by both diagnoses.

In order to compare the amount of tooth movement in the two methods of diagnosis, we have added in each the sum of the individual tooth move-

ments required (from centroid of each tooth to corresponding centroid in the proposed position).

In our diagnosis the movement is 14.6 mm. With the Simon's method, the movement is 66.3 mm., and the result is a worse malocclusion than we started with.

If this girl had a pronounced malocclusion, imagine the result of treatment based on Pon's table.

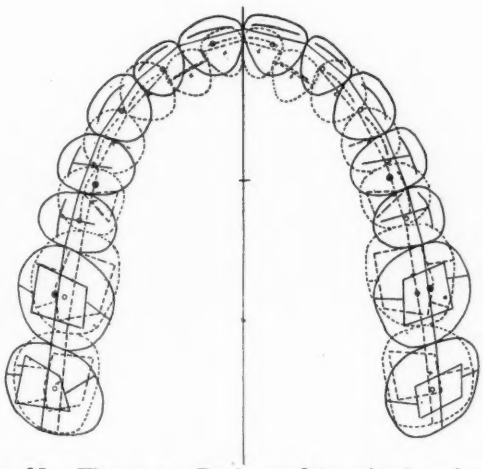


Fig. 35.—Eby case—Pon's predetermined occlusion.

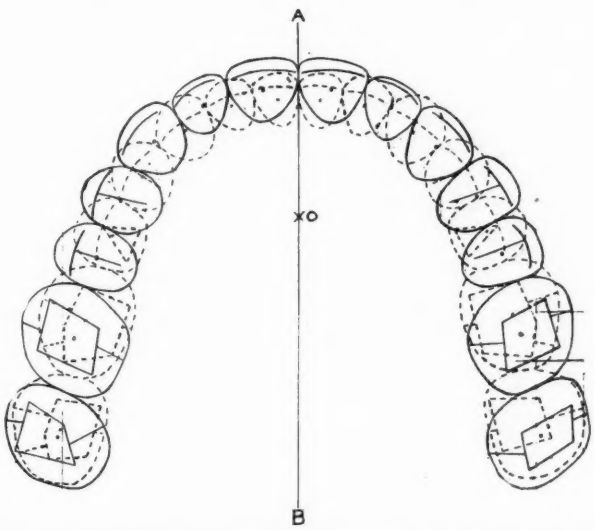


Fig. 36.—Eby case—occlusion map F.L.S. method.

In leaving this phase of Simon's work, it seems wise to suggest to orthodontists that no plan of arch determination should ever be given consideration unless the plan takes cognizance of the fact that arches vary in form and in the ratio of width to length, and any plan that is not flexible enough to produce curves in three dimensions, with variations, to embrace all normal arches is doomed to failure.

Simon's next test of the abnormal denture is to compare the "occlusal

curves'' of the case in hand with the norm. It is most unfortunate that the correct term was not used in describing this graph. It is a development, i.e., the two curves that pass over the buccal cusps and incisal edges of the maxillary and mandibular teeth are stretched out and are plotted to a plane. When two curves of different radii are developed to a plane, it is a physical impossibility in the type of projection used by Simon to preserve the correct

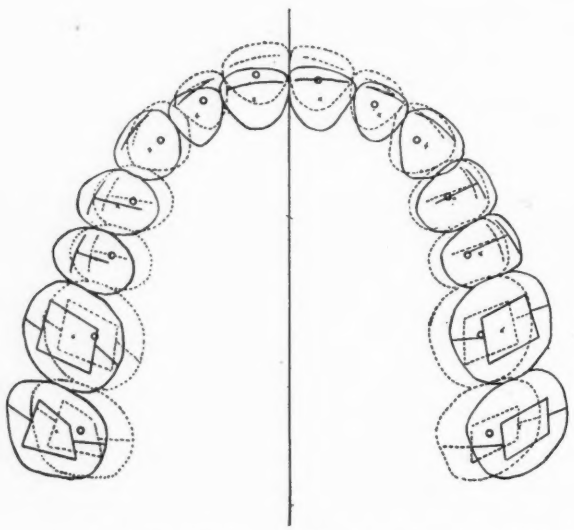


Fig. 37.—Eby case upper related to Pon's predetermined upper. Solid line, survey of upper model; dotted line, proposed arch (Pon's).

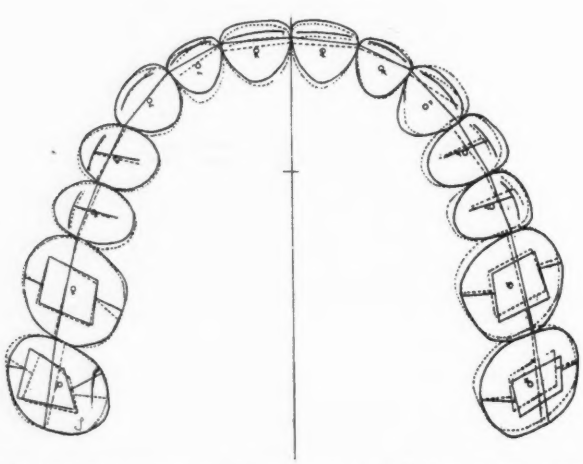


Fig. 38.—Dotted line survey of Eby upper. Solid proposed arch (F.L.S.).

interrelation of points on the two curvatures except in one dimension, the vertical. All the up and down relations of the cusp and incisal points are correctly recorded on the graph but it is impossible to preserve either the bucco lingual or front-to-back relations of the teeth. Simon tells in his book how this impossible feat may be accomplished, page 142.

Fig. 41 shows Simon's development of a normal denture. How well the points may be kept in their normal front-to-back relations is shown in the plotting of the left upper and lower premolars, as the upper and lower cusp

points are plotted on the same line. To be sure that the legend might be due to an error in translation, I wrote to Simon and his reply assures me that the plot is made from a normal denture!

In making the graph, the gnathostatic model is placed on its base (Frankfort plane) and the elevations of the cusp points are measured from this base with a suitable instrument (diameter) and plotted as a development of the two curves. Great stress is laid on the value of these graphs in diagnosis as they have not heretofore been done. Page 143, Simon's book. (Fig. 42.)

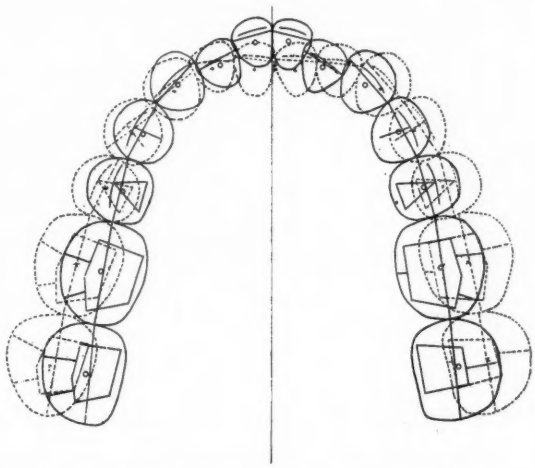


Fig. 39.—Eby lower related to Pon's predetermined arch. Dotted line survey of Eby lower. Solid line proposed lower (Pon's).

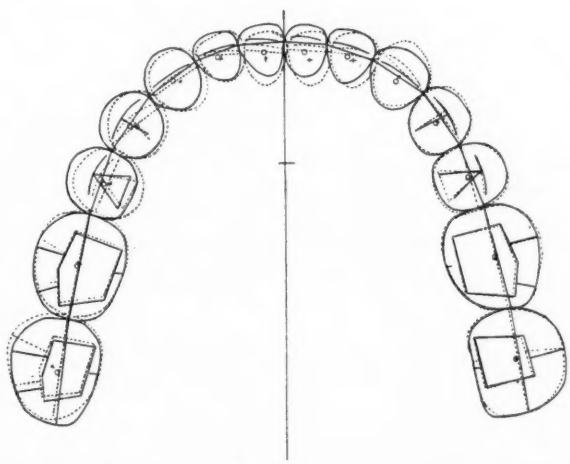


Fig. 40.—Dotted line survey of Eby lower. Solid line proposed arch (F.L.S.).

Figs. 43 and 44 are taken from the author's San Francisco paper (September, 1915) showing not only curves of buccal cusps, but also lingual cusps, fossae line.

In Fig. 45 is shown a horizontal development of an abnormal denture to which has been added an ellipse representing the normal arch form. In the development the ellipse appears as a straight line not related too well to the denture as a whole. The line is rotated to be in better harmony with the

denture, then the process of development is reversed, the denture is returned to its original position of malocclusion, the straight line becomes an ellipse related to the malocclusion to produce the least tooth movement.

Normal dentures when developed on the XZ (orbital plane) present a more uniform appearance than in other projections. As outlined in my paper of 1915, a normal denture is nearly on plane from the contact of the upper centrals to the mesial contact of the first molar curving upward back of this

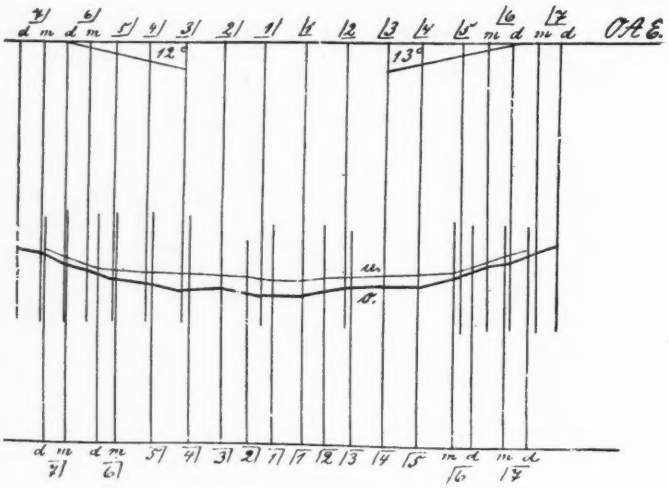


Fig. 41.

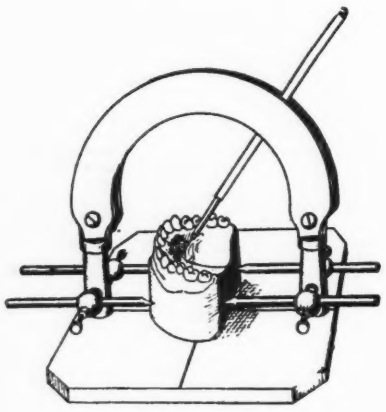


Fig. 42.

point. The vertical overbite of the incisors is a varying distance and the up curvature back of M^1 varies. Due to this constancy of form of the norm in this projection, Simon's graph is his only graph that is a reliable guide for orthodontic diagnosis. (Fig. 46.)

A safer comparison may be obtained by leveling each model on the occlusal plane instead of the Frankfort plane as the angle of the occlusal to Frankfort plane varies in the norm with consequent distortion of the projection. While this angulation is not great and would not materially effect the projection, still it would be safer to project from the occlusal plane.

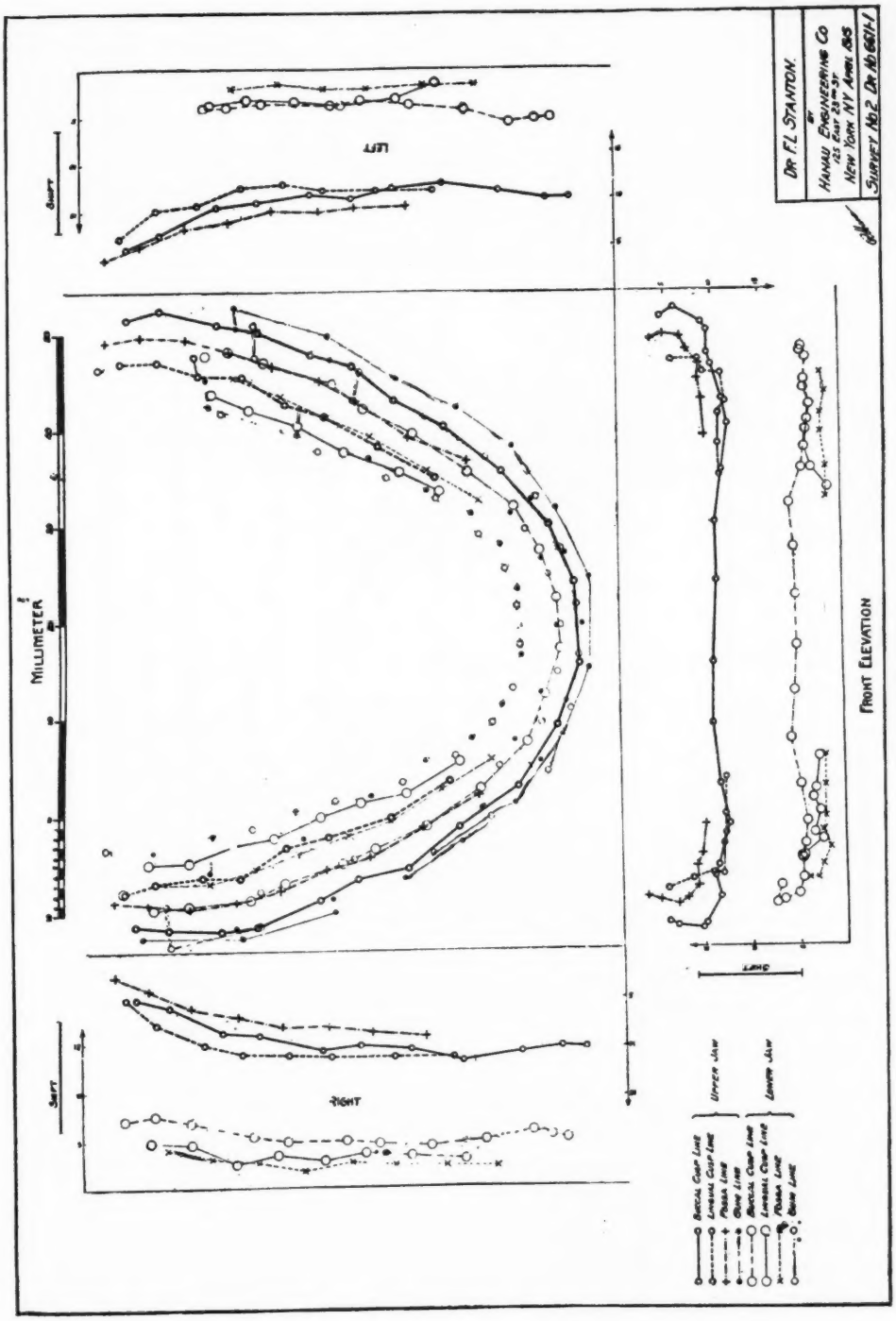

Dr F.L Stanton
Hanau Engineering Co
125 East 23rd St
New York NY April 1925
Survey No.2 Dr No 6614
Millimeter
Left
Right
Front Elevation
Upper Jaw
Lower Jaw

Fig. 43.

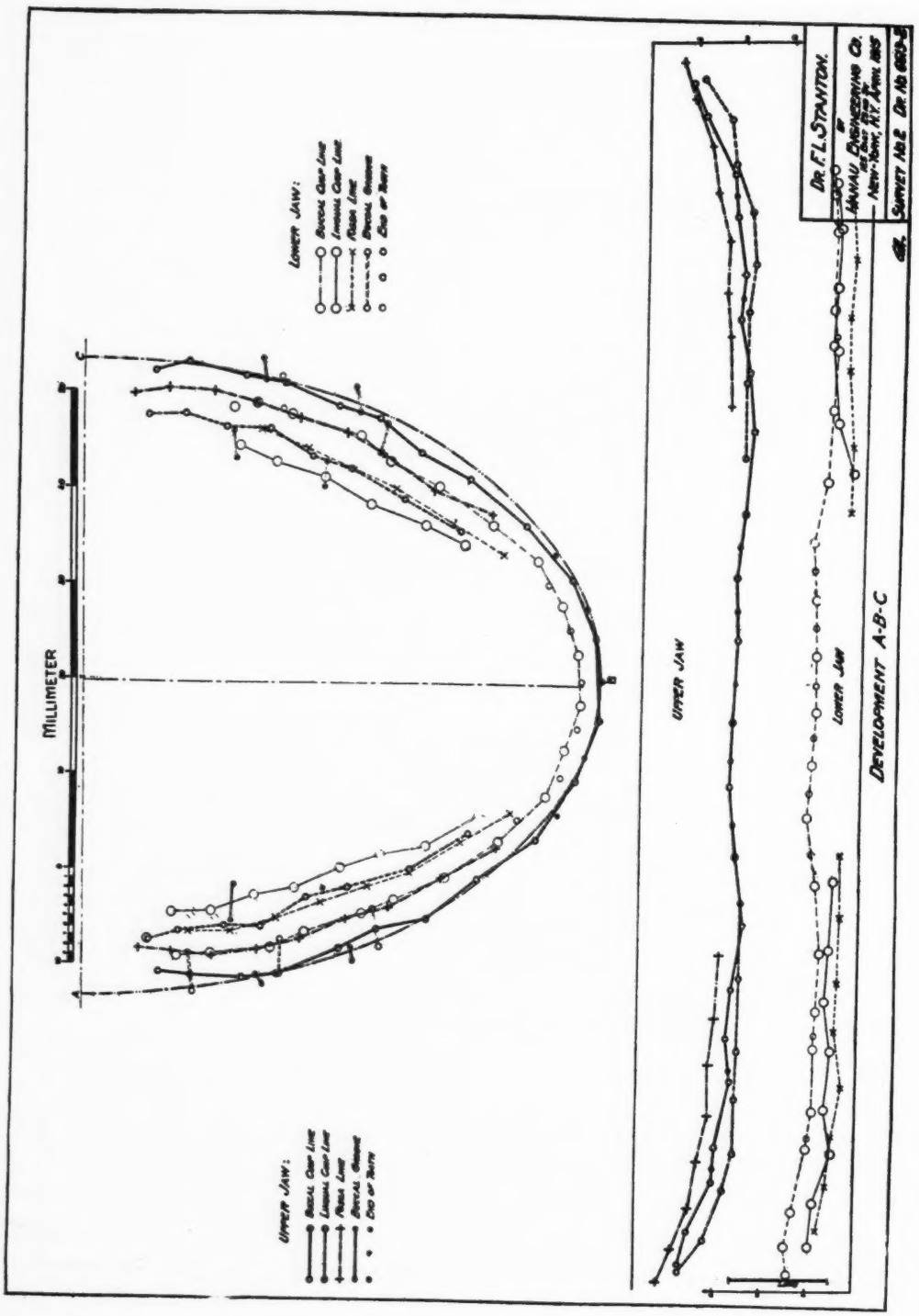

DR. F. L. STANTON.
DEVELOPMENT A-B-C
UPPER JAW
LOWER JAW
MILLIMETER

Fig. 44.

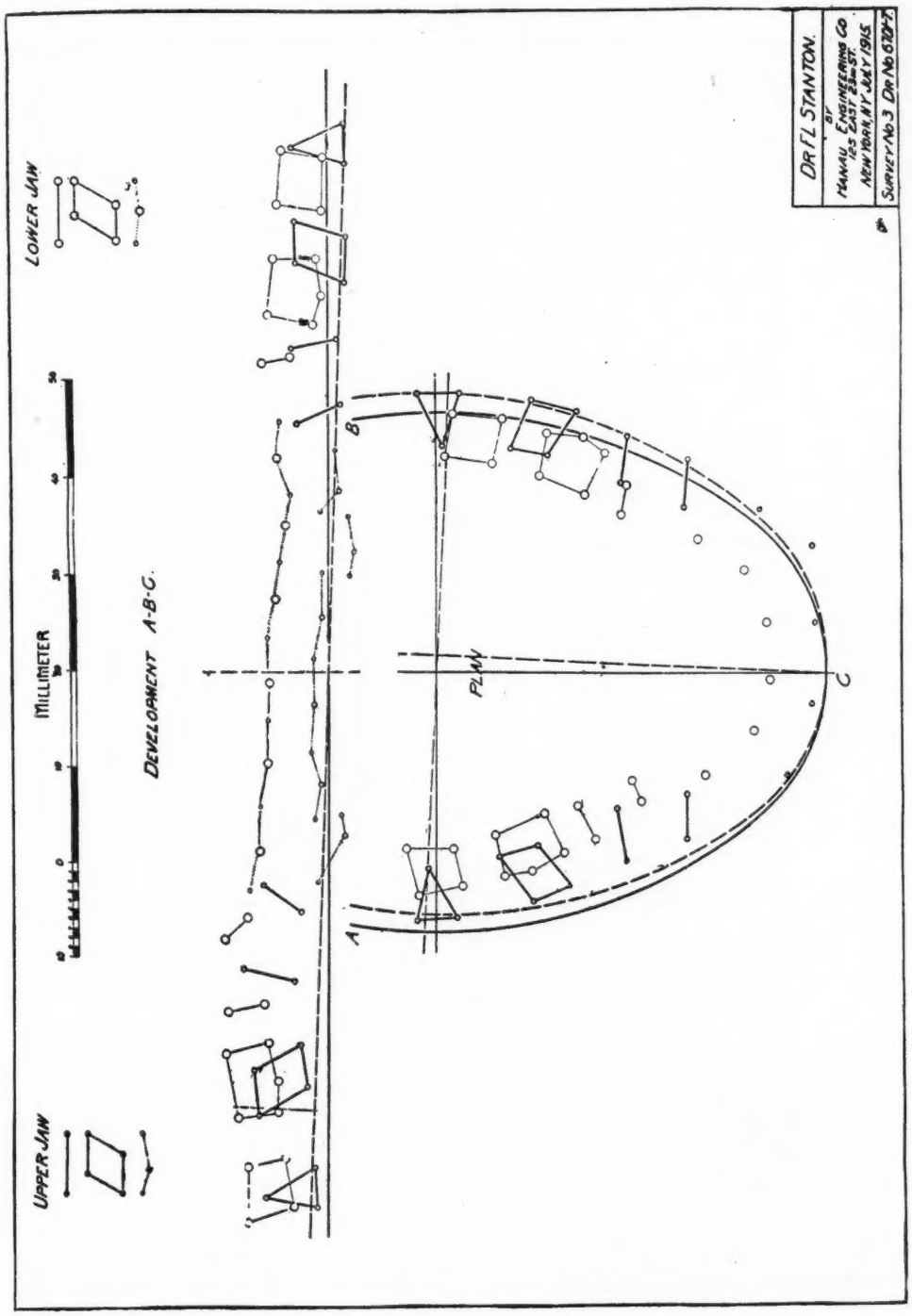

DR F L STANTON.
BY
HANAU'S ENGINEERING CO
245 E 23RD ST
NEW YORK, N.Y. JULY 1915
SURVEY No 3 DR No 6704-7
LOWER JAW
MILLIMETER
DEVELOPMENT A-B-C.
UPPER JAW
PLAN
A
B
C

Fig. 45.

Simon next proposes a graph of a sagittal section of the palate, as shown in Fig. 47. From a composite of four norms he proposes that the orthodontist shall evaluate the abnormality of any case. The plot is made from elevations

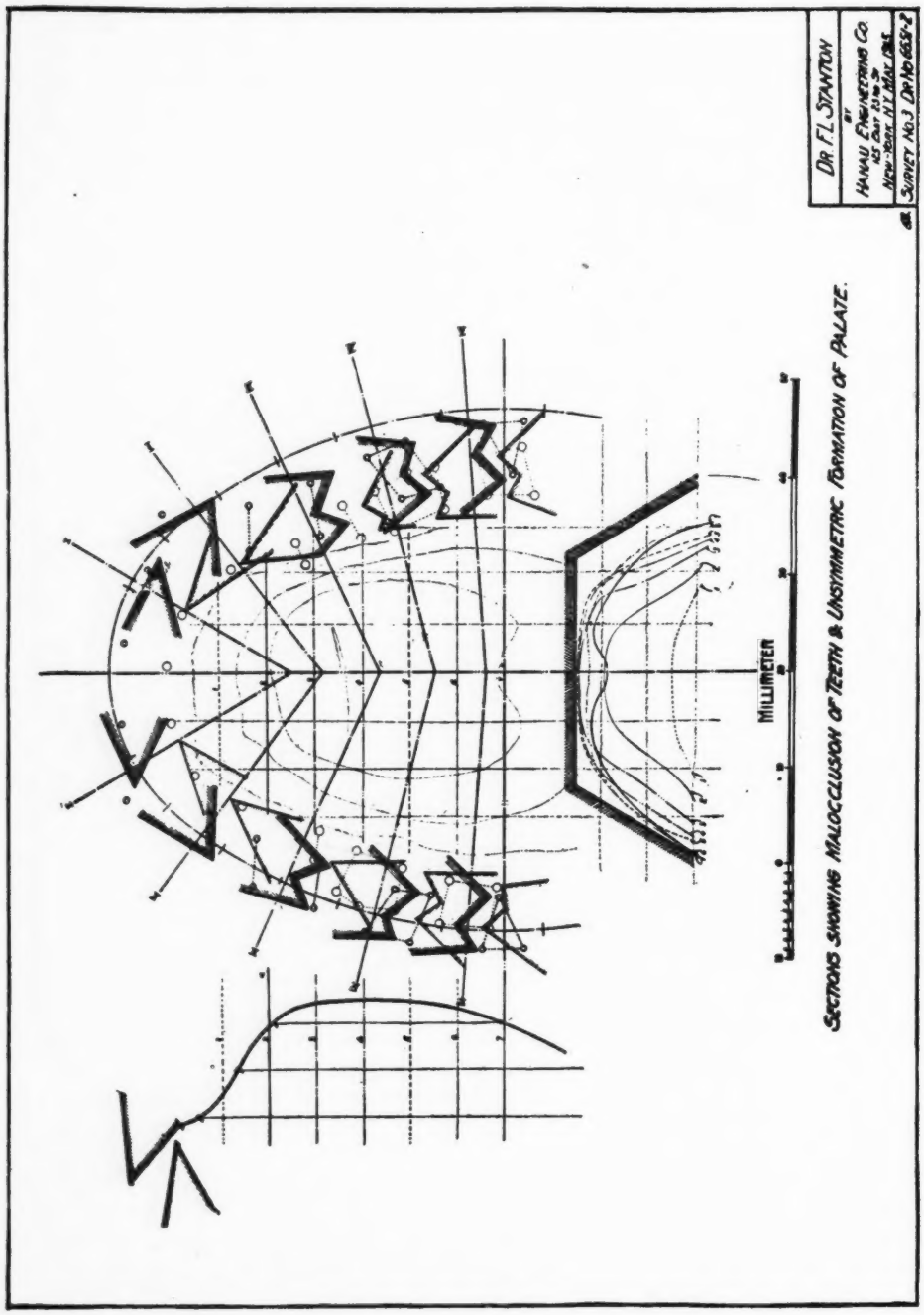


Fig. 46.

read from the Frankfort plane, hence the diagnosis will show whether the palate is too high or too far from the Frankfort plane, whether it is correctly inclined from front to back, and the prosthion is too far forward or not.

The futility of such an assumption can be shown by Fig. 48, taken from

an old book of Huxley. The wide range of variation in the norm of this line not only in linear distance from the Frankfort plane but also in angulation and in front-to-back relations, render it useless for diagnosis unless accompanied by a table of the range of variation of the norm from childhood to adult life.

Simon seems to feel this for in Case No. IX, Fig. 106, he says "possibly the error is due to the age of the child." (Fig. 49.)

To more clearly show the fallacies of Simon's diagnostic methods, I have selected two skulls that exhibit malocclusion and growth aberrations. In Fig. 50 you see the projections of the Frankfort and orbital planes. The latter passes 1 mm. in front of the buccal groove of the maxillary molar. Our first deduction (Simon) would be that the first molar needs to be moved back 19

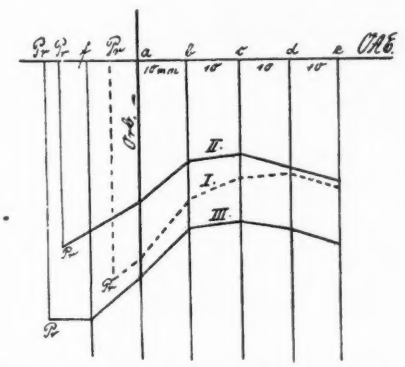


Fig. 47.—Median sagittal palate curves. *Pr*, prosthion.

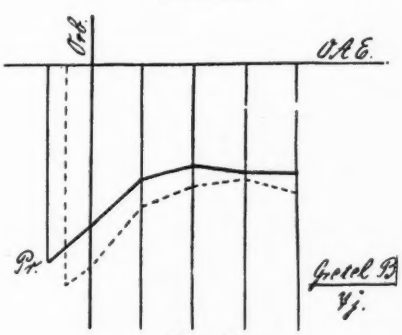


Fig. 49.

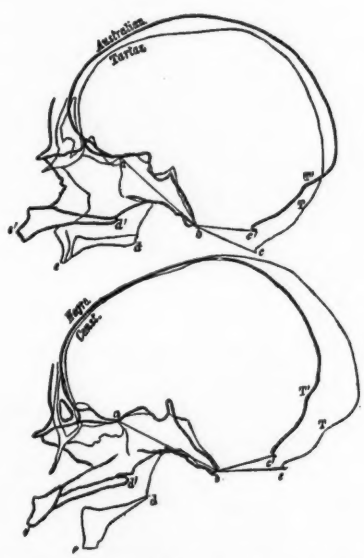


Fig. 48.— Sections of orthognathous (light contour) and prognathous (dark contour) skulls, one-third of the natural size. *a b*, basicranial axis; *b c*, *b' c'*, plane of the occipital foramen; *d d'*, hinder end of the palatine bone; *e e'*, front end of the upper jaw; *T T'* insertion of the tentorium.

mm. If we should pursue further an orthodontic diagnosis we would be led into all sorts of absurdities. On the other hand, if we dismiss the idea that the true relation of the denture to the head may be found by measuring from Simon's three planes and proceed in a more rational way to make a complete examination of this skull, we would find:

The cranial capacity is a trifle more than one-half normal. Patient died in an insane asylum. Failure of brain and cranium growth retarded forward growth of the upper jaw and its contained teeth. The mandible not being so intimately related with the cranium has not suffered like the maxilla in the arrest of growth of the cranium. In this case it would be better to diagnose the aberration of growth and malocclusion from the mandible rather than from the orbital plane, thus turning the Simon's plan upside down.

Our last case presents an aberration of growth (Fig. 51). Wingate Todd points out "growth of the face is not only change in bulk but change in proportions." In this case, while we have increase in size, the proportions of

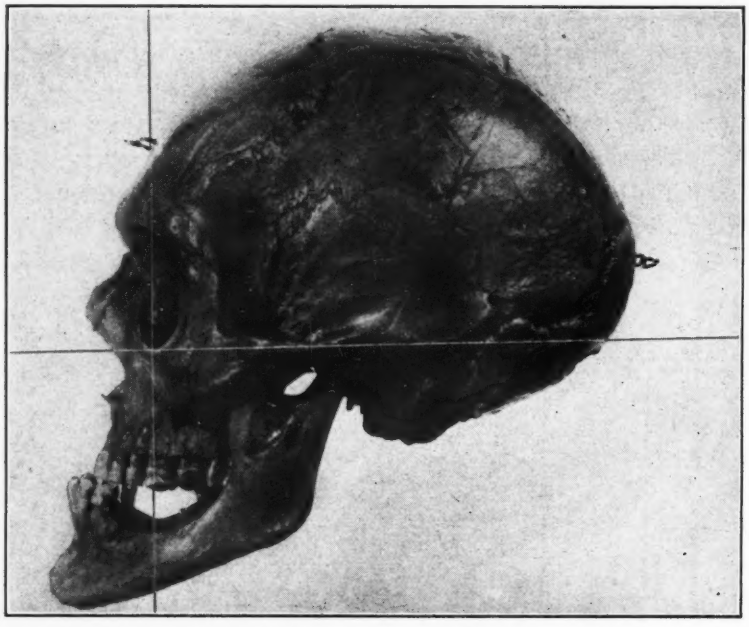


Fig. 50.—(Prepared by Wingate Todd.)

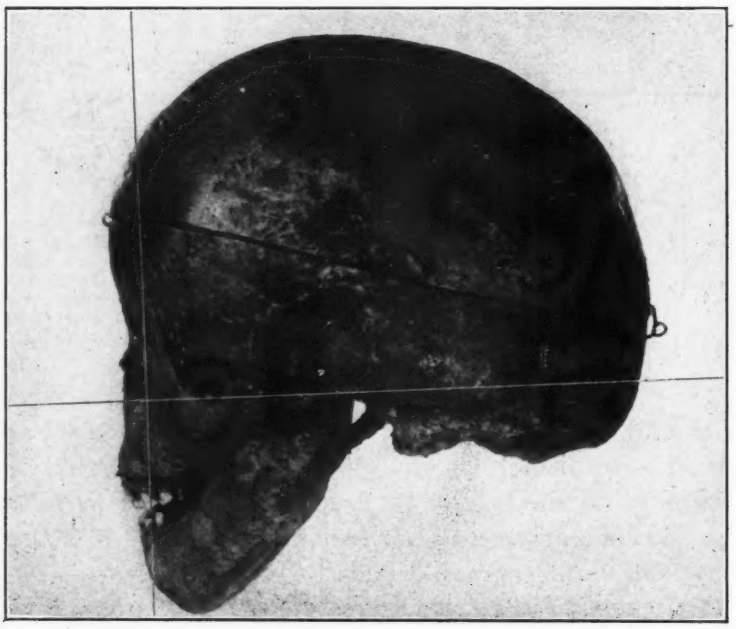


Fig. 51.

the face are those of a child, the face has failed to emerge from the cranium. If artificial dentures were to be made for this case, they would have to be made to fit the bases as they are and if they were to function, they would have to conform to the motions of the mandible. If orthodontia were to be

attempted, the same principle would have to be followed, i.e., the teeth would have to be placed in the best functional relations in those jaw bases and in harmony with the mandibular movements. While precise anthropometric measurements might tell us that the denture belonged many mm. in front of its present position, we know of no way to accomplish such changes with orthodontic appliances.

CONCLUSIONS

Craniometry offers a rich field for orthodontic research, but great care should be exercised in accepting the findings of orthodontists, working in this field, unless the work has been supervised by competent anthropologists.

The acceptance, by orthodontists, of such obviously incorrect findings as the Simon presentation, will tend to destroy the cordial relations with anthropologists established by a few careful orthodontists.

In a precise method of mensuration, it is wrong to substitute modelling compound for plaster of Paris impressions.

The "Orbital Law of the Canine" has no foundation in fact.

In attempting to find the horizontal form and dimensions of the dental arch in advance of treatment, no table of averages (such as Pon's table) should be used. Each case is a law unto itself.

No average norm should be accepted by orthodontists; the normal range of variation for all ages and races must be known.

No three-plane system can be of service to orthodontists if two of the planes depend on the judgment of the operator.

In the development of two curves of different radii it is possible to show the interrelation of points correctly in but one elevation.

Simon's plan to photograph all patients in the same relative position is worthy of adoption.

NOTE:—Since completing this paper, the author wishes to call attention to a paper by Connolly of Washington in the Journal of Physical Anthropology (Jan.-March, 1927). At the instigation of Hrdlicka, Connolly undertook to evaluate the Law of the Canine. From the examination, Connolly concludes "it would be dangerous to predicate any diagnosis on such a premise." In addition he shows conclusively that the orbital point bears no fixed relation to the other skull points.

The author gratefully acknowledges the assistance given by Wingate Todd of Western Reserve Medical School and to his associates, Drs. Sorenson, Mason and Ethel Luck for their conscientious work in preparing the India ink drawings for the illustrations. Broadbent of Cleveland and Okada of Tokyo also gave valuable help.

DISCUSSION

*Dr. Milo Hellman.**—Dr. Stanton's paper is a worthy contribution to the topic which has taken an undue hold on the orthodontic profession. His treatment of the subject is thorough and his conclusions well arrived at. There is nothing but favorable comment to be made in the discussion of this paper. I shall only make a correction of the statement referring to my findings relative to the canine angle; namely, as the growth of the face proceeds from infancy to adulthood, the canine angle becomes more acute. In infancy

*Dr. H. having been away when Dr. Stanton's paper was read, was requested to submit his discussion in writing.

it approaches quite near to a right angle. But as the face mask "swings" forward in the course of development toward the adult, it gets *smaller*. But the fact to be remembered is that the angle varies at every stage of development. For instance, in one adult white male group, with the dentitions in normal occlusion, the average for the canine angles is 75.21,° but the standard deviation is ±3.73.° This means that the variability of the canine angle in this group is from 71.48° to 78.94,° a range of 7.46.° In another group of white males the average for the canine angle is 77.14° and the standard deviation ±4.07.° In this instance there is a range of variability of 8.14.° I offer this explanation in support of Dr. Stanton's contention that "No table of averages should be used" without the statement referring to the range of variability.

I should at this time also like to call the attention of the readers to a certain fact brought out in my paper, read May 2. Namely, when the canine angle of skulls with cases of malocclusion known as Class II, division 1, is compared with the canine angle of skulls with dentitions in normal occlusion, it is found that in the former the angle is less acute than in the latter. This means, that in Class II, division 1, cases the position of the upper canine is *not* more forward, but rather further back in relation to the orbit than in the normal.

There is nothing more for me to say but compliment Dr. Stanton for his thorough and clear paper. It was a pleasure to read it and I endorse his conclusions completely and whole-heartedly.

Dr. Martin Dewey.—We have just listened to a very wonderful presentation of a subject in a scientific manner, but all through the presentation of this subject I could not help being impressed with the unfortunate aspect which was constantly bobbing up, or making its appearance; namely that it is very hard to separate a scientific discussion from personalities. The very title of Dr. Stanton's presentation was unfortunate in that it was a critical review of some other man's work, and regardless of how accurate a presentation may be from a scientific standpoint, you are going to offend somebody's feelings when you criticize someone else's work, because they look at the personal aspect.

Science knows no friends. A premise is either correct or incorrect. The unfortunate thing has been, so far as orthodontists have been concerned, that Simon's presentation starts out as a critical attack on Angle's classification. The arrangement of his book is in three parts; the first part devoted to a critical review. Then he presented his subject all the way through, not so much as a scientific proposition, but by trying to show that he was right and the rest were wrong.

Unfortunately, Dr. Stanton could be placed in the same position. But that is, as I said before, an unfortunate thing as far as scientific investigation is concerned. What I would ask you to do is to eliminate from your minds the question of whether Simon said this or Stanton said that, or whether Dr. Hellman made such a statement, but go back and investigate these things for yourselves. Find out whether some of these statements are true, regardless of who makes them.

As a final analysis, truth will prevail, regardless of what I say or what Dr. Stanton says or Dr. Hellman or anyone else, but regardless of what any one says be sure to keep your feet on the ground and not be carried away by your personal likes or dislikes for the investigator, and remember that orthodontia is a science closely associated with an anthropological investigation. There is great value in having a diagnostic point relating to the cranium, if it can be found. There is value to the three-plane method of diagnosis, but also remember that every individual, to a certain extent, is a law unto himself. He comes into the world with certain inherited characteristics which are influenced by certain environmental surroundings. As a result of that you must remember that what you find in one will be a little different from what you find in another. An exact law in biology is impossible, because all biologists recognize a certain amount of variation.

The most unfortunate thing, I think, in Dr. Simon's presentation was that he pinned his entire principle, as I see it, upon the law of the canine which has been attacked by almost every anthropologist in America. Unfortunately, when that part of his statement falls down, people discredit the rest of the work. There are lots of good things in Dr.

Simon's presentation, but others will have to be investigated, and I am simply begging of you to lose sight of personalities and take the thing from the purely scientific standpoint.

Dr. Frederick L. Stanton (closing).—I want to endorse Dr. Dewey's remarks. If any value is to accrue to your Society you must consider the subject matter of my paper rather than the manner of presentation. When Socrates made his final plea he said: "Never mind my manner which may or may not be good; but think only of the justice of my cause and give heed to that; let the judge decide justly and the speaker speak truly."

So I leave my paper with you asking you to ignore my manner which may or may not be good, and consider only the message which may or may not be true.

POSITIONS OF THE HEAD AND MALRELATIONS OF THE JAWS*

By Dr. A. M. Schwarz, Vienna

(A Report of Work Done in the Laboratory of Dr. B. Gottlieb, University of Vienna, Department of Dentistry, Dr. R. Weiser director.)

Translated by Dr. Egon Neustadt, New York City

ANGLE understands occlusion as the relationship of the jaws at rest,† but he means the position of the jaws when they are locked. In this position, the muscles of mastication are somewhat contracted. If all the muscles are entirely relaxed and the jaws are at rest, the teeth are separated even if the lips are closed.

The position of the jaws at rest is dependent upon the position of the head. This can be seen from the radiograms of a child five years old who had normal occlusion (Fig. 1).

In dorsiflexion of the head, the teeth are comparatively far apart. The mandible at the same time is posterior as in a Class II case. In ventroflexion just the contrary takes place; the teeth touch but not in normal occlusion, for the mandible is anterior as in a Class III case. The difference between the two positions in anteroposterior direction is the width of two premolars.

Consequently, different positions of the condyle in the glenoid fossa correspond to those different positions of the teeth (Fig. 2). In ventroflexion, when the teeth touch, the condyle is on the tuberculum articulare; in dorsiflexion, with slightly open mouth, it lies in the depth of the fossa. In extreme dorsiflexion, the mouth opens rather far automatically, the condyle remaining in the fossa. During this movement, the mandible has made a *simple hinge movement* in the temporomandibular articulation (Fig. 3).

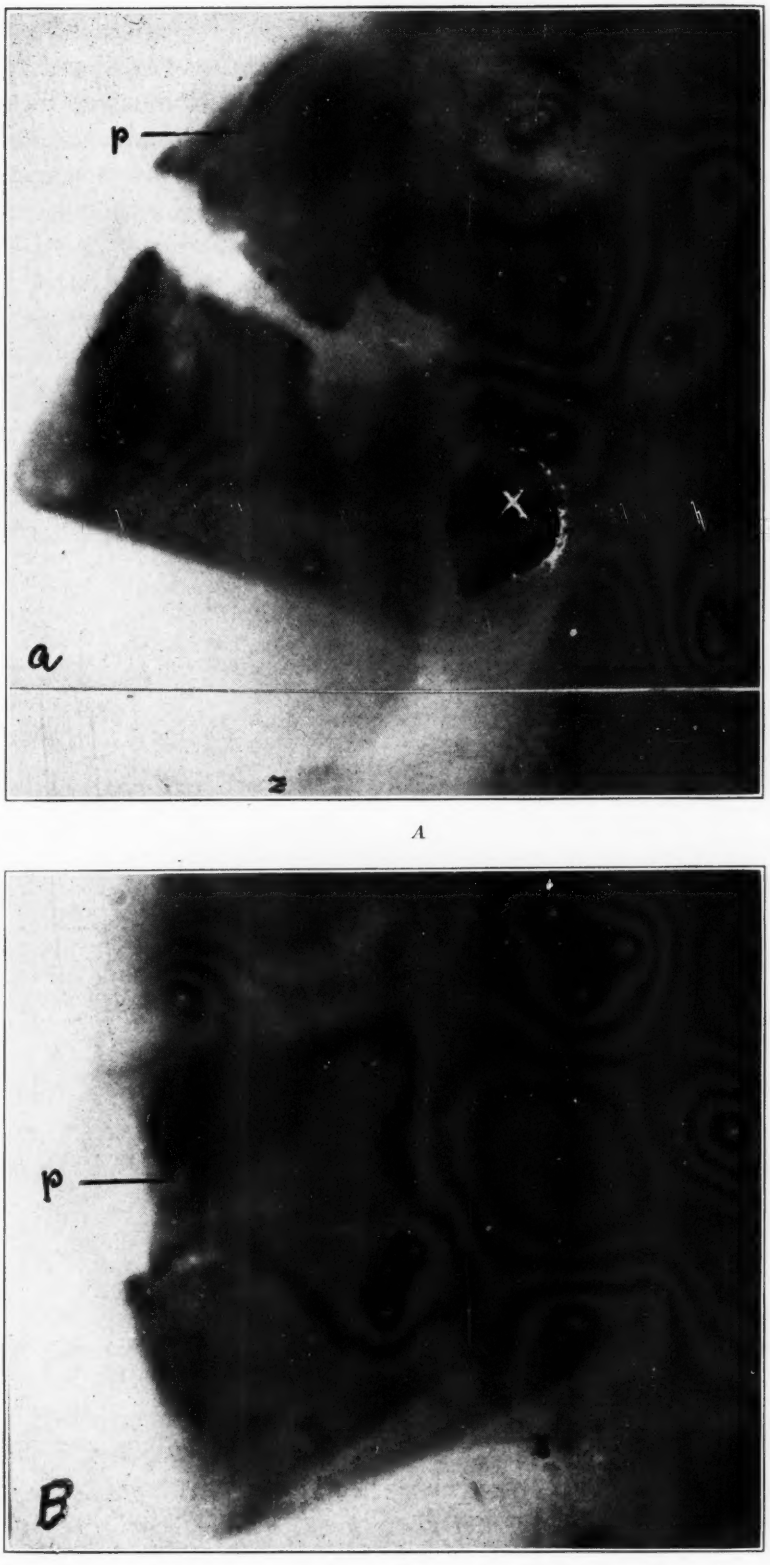
The distance of the hyoid bone from the incisive papilla is about twice as great in dorsiflexion as in ventroflexion of the head (Fig. 1). Changes in the position of the head also produce changes in the position of the tongue in the oral cavity.

This pronounced difference in the position of the jaws can also be studied on the profile (Figs. 4 and 5). The automatic movements of the mandible in changes of positions can be palpated with the finger.

The explanation for this fact is simple: If a piece of rubber is bent the parts on the convex side are stretched, on the concave side they are compressed. If we bend the head forward, all the soft tissues in front of the spine are compressed. The opposite occurs if we bend the head backwards. If we bend the head to the left, the soft parts on the right side are stretched, those on the left side are compressed. If we bend to the right, the opposite occurs.

*This topic was thoroughly treated in "Kopfhaltung und Kiefer": Oesterreichische Zeitschrift für Stomatologie. 1926. Heft 8 and "Die automatische reine Scharnierbewegung im Kiefergelenk," ibid. 1927, Heft 3.

†This definition appears in the introduction to *E. H. Angle's* "Malocclusions of the Teeth."



A

B

Fig. 1.—X-ray of a five-year-old child. *A*, in dorsiflexion (passive) of the head; *B*, in ventroflexion (passive) of the head; *z*, hyoid bone; *p*, region of incisive papilla. A separation was placed between the first and second deciduous molars in both jaws to locate the points more easily. *x*, fault in the film.

If we slit a piece of rubber across one surface, the cut opens by bending the piece toward the intact surface or by torquing it; by bending it toward the slit surface the cut closes. In a similar way the skin and soft tissues of the face react with the mouth as its opening. The mandible permits movements not only upward and downward, but also ventrally, dorsally, and laterally.

A heavy fold can be raised in the mandibular region in ventroflexion of the head; only a small one, in dorsiflexion. In dorsiflexion, the stretched skin acts upon the mandible the same as if a sheet of rubber were stretched across it, fastened above in the region of the nose, the orbit, and zygomatic arch; below on the clavicles; laterally on the M. sternocleidomastoideus (Fig. 6). This force presses the mandible distally in proportion to the dorsiflexion of the head.

The soft tissues of the mouth and the internal organs of the neck also play a part in this mechanism. When the head is in a normal position, the muscles lie comfortably beside each other in a recess formed, dorsally, by the

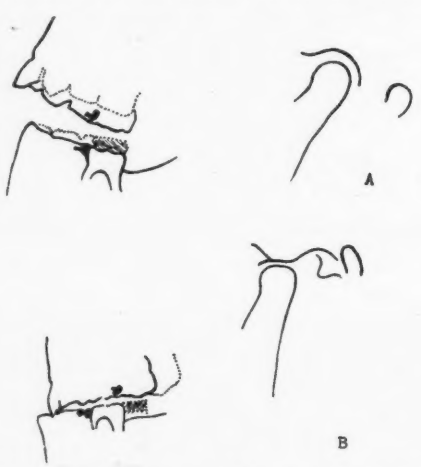


Fig. 2.—Diagrams of Figs. 1-*A* and 1-*B*.

cervical portion of the vertebral column and its muscles; cranially, by the palatine arch; laterally and ventrally, by the lingual surface of the jaw bones. In ventroflexion this recess gradually becomes narrower and the soft tissues within are compressed like a rubber sponge. The expansive force presses the mandible mesially in proportion to the dorsiflexion of the head.

In a passive ventroflexion of the head, the floor of the mouth can be pressed in with the finger quite deeply from the outside, and the compressed oral tissues felt. In passive dorsiflexion, the touching finger meets with strong resistance from the stretched tissues on the floor of the mouth.

The space available for the internal organs of the mouth and neck is too small in ventroflexion and too large in dorsiflexion. For this reason, the atmospheric pressure shows considerable changes according to the position of the head. These changes are certainly greater than those due to abnormal breathing. *In ventroflexion, there is a positive pressure in the oral cavity; in dorsiflexion, a negative pressure;* therefore there is suction so long as the lips are closed. These forces act independently of the position of the body, and the weight, which changes in accordance with the position of the body, is of

hardly any influence if compared with them. In dorsal or ventral positions of the body, if the head is turned laterally, the side facing the shoulder is relaxed (ventroflexion). The side turned away is stretched (dorsiflexion). As a result of these forces which are so different and opposed to each other, there results an asymmetric relation of the mandible to the maxilla.

The physiologic position of the jaws at rest is therefore dependent upon the position of the head. It is obvious to assume that the development of the jaw will be permanently influenced by the position of the head if it is habitually or forcibly kept in one certain position. To examine this question, the fol-

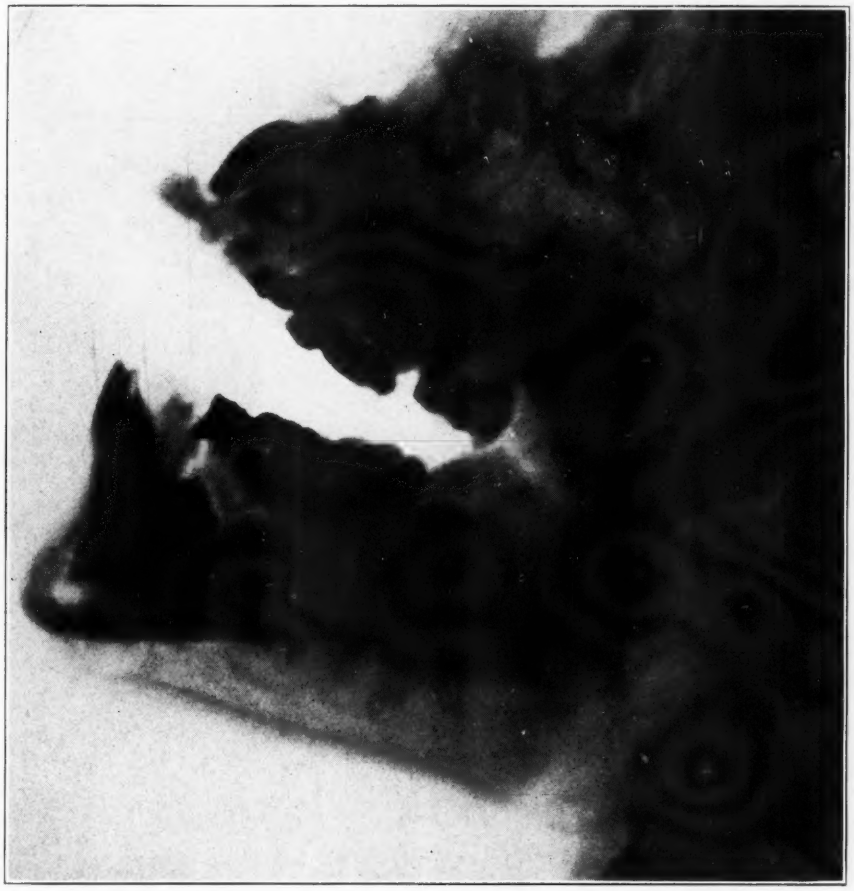


Fig. 3.—X-ray of a six-year-old child. The head is in extreme dorsiflexion. The mouth is automatically rather widely opened, the condyle is in the depth of the fossa.

lowing experiments were made with a patient thirty-five years old who had lost all the teeth of the upper jaw through an atrophy of the alveolar bone. Upon shellac base plates which fitted the palate, wax walls* were built corresponding in outline to the rubber plate that the patient wore. Several wax forms were made and each left in the patient's mouth for twenty minutes; one in dorsiflexion of the head with mouth closed (passive) (Fig. 10-*A*); one in dorsiflexion of the head with mouth open (passive); one in ventroflexion of the head with mouth closed (Fig. 12-*B*). After being left in the

*The wax used was soft at mouth temperature.

Fig. 4.—Profile of a thirty-year-old person. The jaws are at rest. *A*, head in upright position; *B*, head in dorsiflexion; *C*, head in ventroflexion.

mouth for twenty minutes, they were chilled with cold water, then removed and plaster casts made. The characteristic distortion of the wax forms is shown for comparison in Figs. 7, 8, 9, *A, B, D.*

Another experiment was made in dorsiflexion of the head with the mouth open (passive) (Figs. 8, 9, *C*). The anterior portion of one of the wax forms was removed and the two lateral alveolar parts connected by a thin strip of copper which took the exact position of the anterior teeth on the patient's plate. This form was worn by the patient for twenty minutes and then treated like the others. The distortion in dorsiflexion of the head with mouth

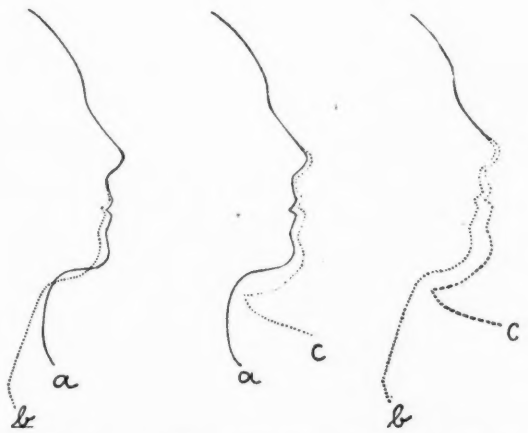


Fig. 5.—The profiles of Fig. 4 superimposed for comparison. *a*, profile in upright position; *b*, profile in dorsiflexion; *c*, profile in ventroflexion.

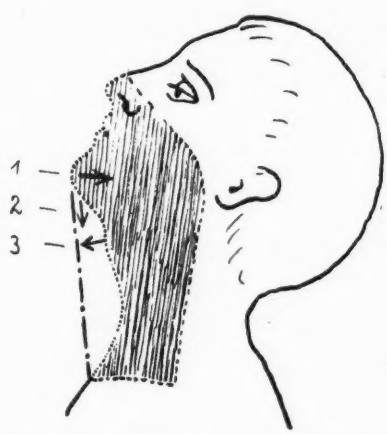


Fig. 6.—The hatched parts signify soft tissues under increased tension when the head is in dorsiflexion. Arrow 1 indicates the result of the tension forces upon the mandible in a posterior direction, arrow 2 in a downward direction. Arrow 3 indicates the tendency of the soft tissues of the front part of the neck to arrange themselves in the line of least distance from chin to chest (—.—.—.—.—.). The stretched soft tissues of the front part of the neck do not only draw the mandible downward (opening of the mouth), but with one vector also backward. This vector increases when the head is bent more dorsally.

closed shows a compression of the whole alveolar process laterally and anteriorly. Keeping in mind that the mandible is kept posteriorly in those positions, we find a similarity between this experiment and a Class II, division 2, case. The distortion in dorsiflexion with the mouth open, shows a compression of the lateral alveolar parts of the wax form, and on the form with the copper strip insertion, it also shows a frontal protrusion. Considering the pos-

terior position of the mandible, we find a similarity between this experiment and a Class II, division 1, case. The distortion in ventroflexion shows a bulging of the whole alveolar process as a sign of a pressure from within the mouth.

The following mechanical factor should be considered in the etiology of malocclusion. The lower jaw of a healthy child breathing normally through the nose, sleeping with the head bent dorsally, is pressed posteriorly as if the child were wearing a chinpiece. During the day, the forces of normal occlusion repair the slight damage of posterior movement at night. The correct interlocking of the occlusal planes acts as an ideal means of retaining the present occlusion.

If there is no locking of the cusps, the result of the forces pressing posteriorly accumulates from night to night. During two critical periods in childhood, the jaws are not guided by occlusal contact; first, the period when

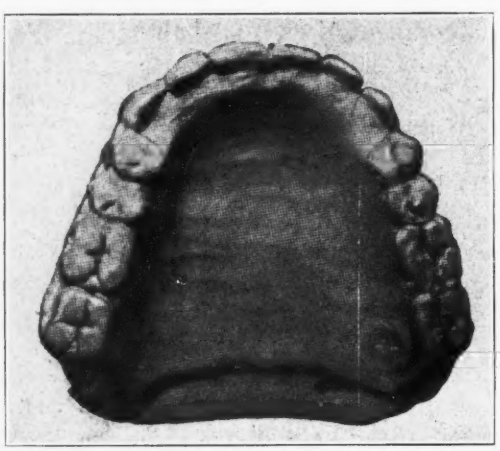


Fig. 7.—Plate worn by the patient after which the wax forms were made.

no teeth are present (first year*), second, the period when the cusps of the deciduous dentition are worn down before the first molars have erupted (between five and six years).

The loss of the crowns of deciduous molars through caries, the premature loss of deciduous teeth, early destruction of hypoplastic molar crowns and similar conditions that deprive the jaws of their guidance, produce complications and damaging effects. A rachitic and abnormally soft bone will, of course, be easily distorted.

Let us assume that a child, six years old, has the deciduous teeth worn down. If the mandible is displaced posteriorly, the upper teeth will protrude. The comparison with a rubber sheet across the jaws shows that the forces of the soft tissues act mainly upon the incisors and canines. At the age of five or six years, those teeth have lost their contact points due to the production of physiologic growth spaces (*Tomes*). Being without support and already loose through the absorption of the roots, they will easily move lingually.

*The position of the head during the last fetal month is of importance. *Weinberger* believes that ventroflexion in utero produces underdevelopment and posterior relation of the mandible, while dorsiflexion produces mesial relation of the mandible. The contrary occurs according to my analysis of the mechanical conditions.

The same malposition will occur in the permanent teeth which are without contact at their eruption and loose due to their shortness and the width of the alveoli. The greater the distance between the jaws, the more will the vacuum, which exists in the mouth when the head is bent dorsally, draw the cheeks and lips lingually. Practically the entire upper arch is pressed lingually. Individual teeth are pushed out of alignment by adjoining teeth (lateral incisors) or displaced labially (canines).

If, after the eruption of the first molar, a posterior occlusion has developed due to the mandible being kept habitually distally, a typical case of

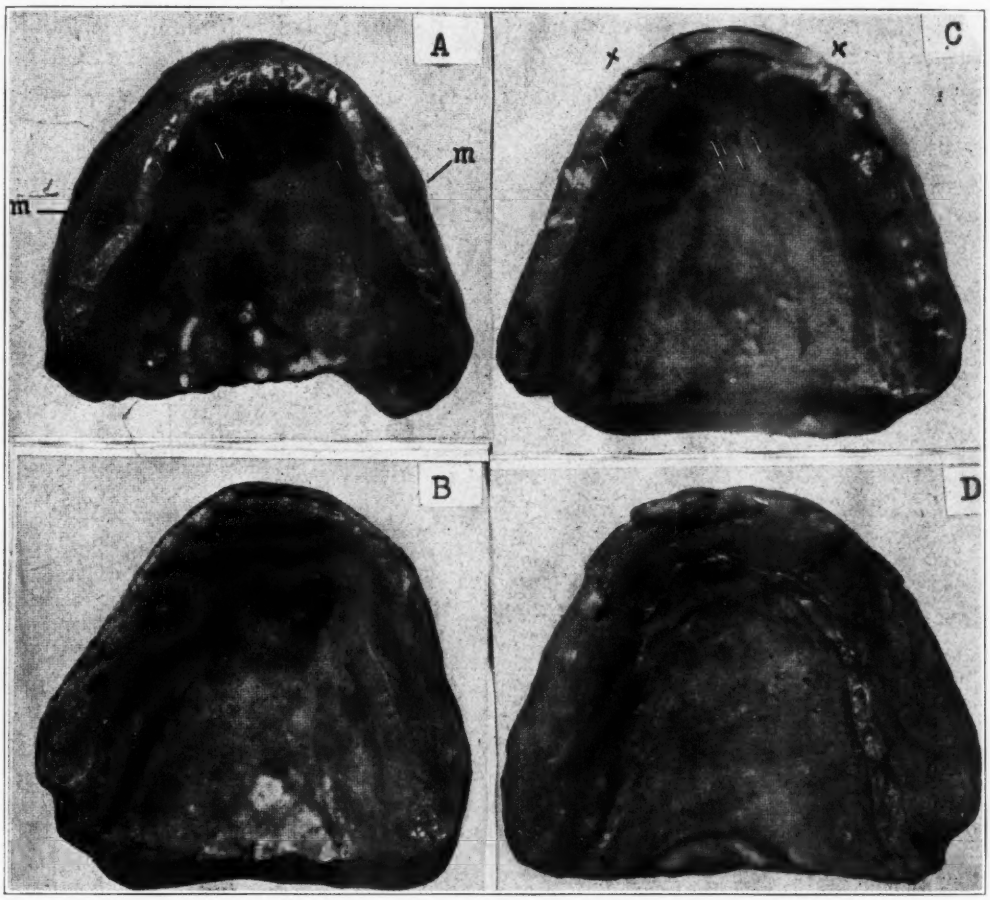


Fig. 8.—Wax forms after they had been in the mouth of the patient for twenty minutes. *m*, the space between second premolars and first molars of plate marked before the experiment was made; *A*, distortion in dorsiflexion of the head with the mouth closed, the position of the patient is shown in Fig 10-*A*; *B*, distortion in the same position as *A* but with the mouth open (passive); *C*, distortion in same position as *B*. The front part of the wax model (between x-x) was substituted by a copper strip; *D*, distortion in ventroflexion of the head (passive) with the mouth closed, the position is shown in Fig. 10-*B*.

Angle's Class II, division 2, will occur as is so often found in children showing no other pathologic conditions. According to present theories, this was explained by the assumption that at one time the patient was a mouth-breather. Of course, that may have been the case; but it was not the mouth-breathing itself that produced the malocclusion. It was the dorsiflexion of the head in conjunction with mouth-breathing at a time when new occlusal contact pro-

duced locking. In other cases, the habit of dorsiflexion was continued after the nasal obstruction had been removed.

The possibility of developing into a *Class II, division 1,* case is easily explained. Suppose there is a pathologic condition in the nasopharynx which makes nasal breathing difficult. *Kantorowicz* believes that this condition of obstructed nasal breathing must exist through a long period before it can cause a deformity of the jaws. This is not very likely because nature tries to avoid unnecessary muscular action. We notice, for instance, that while running, we change from nasal breathing to mouth-breathing long before the necessity actually arises. The sleeping child will soon change to mouth-breathing and do this with the least possible muscular effort. For this reason, it keeps the head in dorsiflexion. In this position, the lips are unconsciously kept apart and the mouth is kept open through the tension of the soft tissues

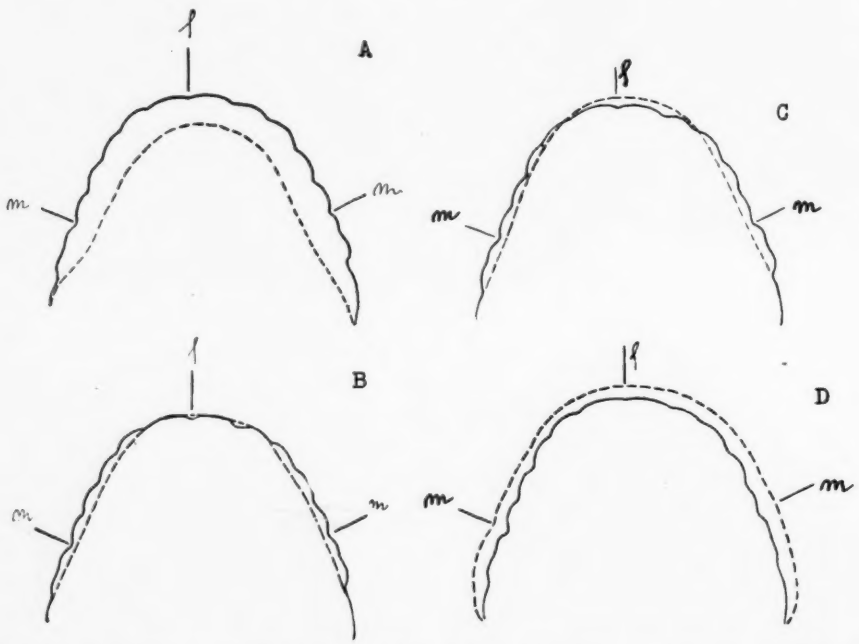


Fig. 9.—Comparison of distortions (dotted lines) of Fig. 8 with the original outline of the wax forms of Fig. 7. *m*, point between second premolars and first molars; *f*, point between central incisors. The deformed models were orientated according to those marks. *A*, Fig. 7 and Fig. 8-*A* superimposed: The alveolar process is bent lingually all the way round (type of Class II, division 2); *B*, Fig. 7 and Fig. 8-*B* superimposed: Lateral compression of alveolar process; *C*, Fig. 7 and Fig. 8-*C* superimposed: Compression laterally and protrusion in front. (Type of Class II, division 1.) *D*, Fig. 7 and Fig. 8-*D* superimposed: The process is bent labially all the way round.

without any muscular action. The base of the tongue is lifted up from the vertebral column and the pharynx is unobstructed. There is no muscular action required to keep the respiratory passage of the pharynx open if the head is in dorsiflexion. A child suffering from any difficulty of breathing will therefore unconsciously bring the head into dorsiflexion. The tongue has a tendency to slip back in the open mouth and to block the pharynx; however, a slight lateral bending of the head overcomes this tendency. *Dorsiflexion of the head with a more or less pronounced lateral position* (either of the head or the whole body) *is the usual pose of a child with disturbed nasal breathing.*

Continual mouth-breathing in dorsiflexion of the head is probably the reason why scientists have attributed malocclusions to abnormal respiratory conditions. The comparison with the rubber sheet can also be applied to conditions where we find mouth-breathing. The sheet now has an opening near the median line, the lips are opened and relaxed but the tissues of the adjoining lateral parts (cheeks) are stretched. The direction of those forces is illustrated in Fig. 11.

Fig.10-*A*.—Position of patient in the experiments 8-*A, B, C*. For experiment 8-*A* the mouth was kept closed.

Fig. 10-*B*.—Position of patient for the experiment 8-*D*.

If the head is in dorsiflexion and the mouth open, the tissues act like a rubber band fastened in the region of the alae, crossing the region of the upper canine, the premolars, and the first molar, backward and downward, crossing the mandible in front of the masseter insertion, and ending in the lateral part of the neck. The result of these forces must be the typical narrowing of the maxillary arch in the premolar region and at the same time a protrusion of the anterior teeth. The prominent alveolar process and the high palate in the anterior part can be considered as places where the maxillary

arch has yielded to the bending stresses of a lateral compression. This is the typical malformation of the maxillary arch in a Class II, division 1, case.

Angle found the explanation for this in the increased pressure of the cheeks when the mouth was held open by muscular action. It is possible that persistent crying of babies and their spastic muscular effort to keep the mouth open will produce the typical deformity, especially if the bone is rickety. According to my view, however, the mouth is not held open for any length of time by *active* muscular action, particularly not at night.

If the forces act principally on one side as when the head is bent laterally, the types of the *subdivisions* are produced, i.e., the anomaly is more pronounced on one side. If the child is a mouth-breather but is not in the habit of sleeping with the head in dorsiflexion, then a Class II will not develop; on

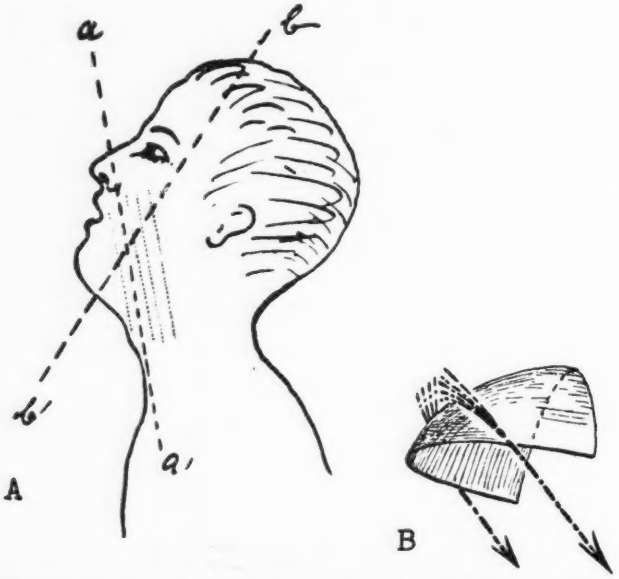


Fig. 11-*A*.—The tension of the soft tissues in the region of the jaws is indicated by the dotted lines, dorsiflexion of the head with the mouth open. A section through *aa'* shows the action upon the upper canine region; a section in the frontal plane (*bb'*) crosses the course of those vectors.

Fig. 11-*B*.—The action of the stretched tissues upon the lateral parts of the arch shown in a diagram.

the contrary, it is possible that through the habit of sleeping in ventroflexion a Class III will develop despite the mouth-breathing.

An *Angle Class III* case and its divisions can be deducted from ventroflexion complicated with a lack of occlusal guidance exactly corresponding to the deductions in dorsiflexion of the head.

If mouth-breathing occurs in ventroflexion of the head, then the teeth are certainly so far apart that a sliding forward of the mandible is not prevented by contact with the maxillary incisors. A movement of the mandible to open the mouth even slightly is now accompanied by a very noticeable sliding forward of the condyle. *Mouth-breathing is therefore an important factor toward the development of a Class III case in ventroflexion of the head.* Mouth-breathing is found mostly with dorsiflexal habits as was explained before, but it is sometimes found together with ventroflexion. I have two patients on

record (Cases 2 and 5) demonstrating the beginning or rapid advancement of the malocclusion occurring at the same time as mouth-breathing started.

The forces controlled by the position of the head are also factors in the etiology of open bite cases, but the deciding factor is probably the pathologic yielding structure of the bone or hypoplastic teeth. (*Kantorowicz.*)

The fact that we see mouth-breathing so frequently connected with dorsiflexion of the head, especially in children, is the main reason for Class II outnumbering Class III cases.

It may be mentioned that symptoms of both types, when found in neutrocclusion, can be explained by the action of the same forces.

The influence of weight compared with the other forces is small if only *temporary* movements of the head are examined, but its *permanent* influence upon the jaws must not be overlooked. Assuming that the body is in a dorsal position we see that the weight increases the forces acting posteriorly when the head is in dorsiflexion, but decreases the forces acting anteriorly when the head is in ventroflexion. This may be another reason for the frequency of Class II as compared to Class III. In lateral positions, the influence of weight

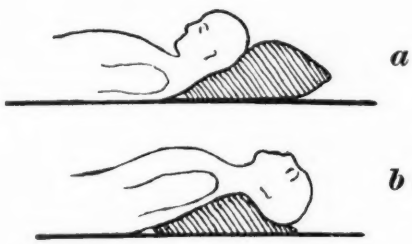


Fig. 12-*A*.—Ventroflexion of the head (dorsal position of the body) caused by resting upon the lower part of the pillow.
Fig. 12-*B*.—Dorsiflexion of the head caused by resting upon the upper part of the pillow.

is usually eliminated through the support of the mandible; if not, asymmetries can develop.

It is instructive to observe the different positions in which children sleep and to analyze the action of the forces in each case. We often find quite pronounced habits where the child arranges the pillows in a certain position and form, then lies down, moving around this way and that until it finds just the "right" position.

The two forces acting in opposite directions are available for *treatment* and can be used to counteract each other. If one discovers a sleeping habit which tends to increase the present malocclusion, it is necessary to teach the child to sleep with its head in a contrary position. Even if such a pathologic habit is not found* it is wise to create more favorable conditions, so that the position of the head may help in treatment. This is accomplished by the proper placing of the head, and maintaining the position through provisions which must not cause discomfort.

*It is not sufficient to rely upon negative statements of the parents. Personal observation of patients in their homes is frequently necessary. Detailed instructions and demonstrations of proper sleeping positions and suggestions for the proper support in accordance with the head form and habits of the child etc, help to insure cooperation in treatment.

If the influence of these forces in different positions of the head can be used satisfactorily in treatment, the *prophylactic value* is at once established. It consists in careful observation of the children at the critical age (one to six years), in establishing nasal breathing, and in instructing the parents as to the importance that the position of the head has during sleep.

Stallard shows in his well-known work a number of photographs of children illustrating their positions during sleep. They are also valuable for my own findings. The photographs, together with the casts of the malocclusions present, furnish an objective proof for my deductions. He shows the illustrations to prove his own deductions and stresses points in positions *other* than I do. In these illustrations, the patients with Class II symptoms have the characteristic dorsiflexion with the mouth open, the patients with Class III symptoms have ventroflexion. I believe that the anomaly in the *relationship* of the jaws is dependent upon the position of the head, while the *malpositions* of individual teeth or groups of teeth are to be explained according to *Stallard*.

The fact that I have found those theories to be in accord with my clinical experience in cases examined for this purpose has encouraged my work and makes me hope that it will meet with sufficient interest to be given consideration in examining similar cases. During the short time since publication in the *Wiener Zahnaerztliche Gesellschaft*, I am pleased that some orthodontists have found these theories to be in accordance with their observations.

I do not wish to be misunderstood as having presented the solution of all the difficult questions in the etiology of malocclusion. My only object is to point at another possibility which may play a part in the development of malocclusion. I believe it safe to say that, whatever the other causative factors may be, *the development* of a Class III case in habitual dorsiflexion and a Class II in habitual ventroflexion is very improbable.

I want to express my gratitude to Dr. B. Gottlieb of Vienna for the advancement of my work.

PRINCIPLES RELATING TO DENTAL HEALTH

THE American Society of Orthodontists subscribes to the following affirmations of items and principles relating to dental health:

Whereas, The correction of malocclusion is primarily a health measure; and

Whereas, The only solution of dental health, both locally and in its relation to general health, lies in the prevention of oral disease; and

Whereas, Dental prevention is effective in inverse ratio to the age of the patient, children's dentistry is the logical field of preventive measures; and

Whereas, The orthodontist needs the complete cooperation of the dentist to insure and maintain dental health before and during orthodontic procedure; and

Whereas, The principles of prevention, listed herewith, have been endorsed by fifteen state dental conventions, three national dental associations, and the Federation Dentaire Internationale; namely:

Proper attention to initial defects,
Particular care and attention to all pits, fissures and grooves before caries appears,
No cavity is too small to fill,
The deciduous teeth should have the same care and attention as the permanent ones, as their maintenance in health is essential to the proper development of adult occlusion; and

Whereas, Disregard of these principles and practices of accepted dental teachings constitutes a transgression of professional obligation to the patient and a serious handicap to orthodontic procedure; therefore be it

RESOLVED, That this declaration of policy is the unanimous expression of the belief of this organization, whose members are called upon to uphold it in all their relations with the dental profession and the public; and be it further

RESOLVED, That these resolutions should be displayed in each orthodontic office and a copy sent to the dentist responsible for the care of the patient immediately on the acceptance of a case; and be it further

RESOLVED, That this action be given publicity in professional journals and copies sent to the secretaries of various state, national and international dental organizations and to dental school associations.

The above resolutions were adopted by The American Society of Orthodontists in annual session, May 2 to 5, 1927, Chicago, Illinois.

Clinics

SLIDING DEVICE FOR CORRECTING DISTOCLUSION*

By Norris C. Leonard, D.D.S., Baltimore, Md.

NO principle in orthodontic treatment is more firmly established than that of intermaxillary anchorage for the application of reciprocal force in the correction of certain types of malocclusion.

In fact, it is this principle upon which the orthodontist depends for success in the treatment of a very large per cent of his cases.

Recognizing the importance of this principle in its application in our specialty I have undertaken to supplement its usefulness with a new device which utilizes only the functional forces of mastication to produce reciprocal adjustments indicated in certain malrelations of the dental arches. It is my belief that functional forces properly directed, and under control, supply the very best mechanical stimulus to bone growth and tooth movements; and that the intelligent employment of these forces in treatment of some important types of cases holds very great possibilities for good.

While many of the etiologic factors in the production of some of these perversions may remain obscure, it is practically certain that their persistence is largely due to mechanical causes which may be overcome. And I think it is logical to believe that with the gradual removal of these restraints through modified stresses of function we will have largely restored a balance through a coordination of force and function, stresses and strains that would favor a resumption of normal developmental processes.

In this clinic I am presenting a device, which I think is now complete, for utilizing reciprocally these natural functional forces, with means under easy control of redirecting the lines of stress so as to change the mesiodistal relations of the maxilla and mandible.

This appliance in its present form represents in construction the result of a gradual evolution over a number of years, during which time the utmost simplicity and efficiency have been sought.

It consists of attachments to be soldered to plain bands adjusted to occluding buccal teeth. The attachment for the lower band carries on its outer, sliding member, a vertically attached lug with slightly sloping margins to form an inclined plane. This lug is so located as to engage a spur, which is also an inclined plane, attached to a plain band on a tooth of the opposing arch. By a slight turn, at intervals, of the screw bar of the lower device the sliding member carrying the lug is slightly shifted, and the bearing of the lug against the spur is increased at the discretion of the operator.

*Clinic before the Twenty-sixth Annual Meeting of the American Society of Orthodontists, Chicago, May 2-5, 1927.

This clinic was also presented before the First International Orthodontic Congress, New York, August 16-20, 1926, and was omitted from the published proceedings of the Congress by the committee editing the proceedings because they thought this clinic had been previously published and reprints made of the same.

When the teeth are brought into occlusion the contacting planes of the spurs and lugs located on either, or both, sides of the arch slide together under pressure of the contracting muscles, and a part of the stress is delivered in the direction desired for development.

The control is accurate, and the action necessarily positive. The quick response of the tissues is indicated by the early disappearance of the feeling by the patient of pressure, or interference, of the contacting planes during mastication.

The attachments are adjusted to the teeth at first, of course, so that the lugs and spurs will be only in the gentlest contact while the opposing teeth are in their usual occlusion from which they are to be changed to normal. Then at the next sitting the bearing is very slightly increased with about a half turn of the adjusting screw bar, on both sides of the arch alike, if it is a bilateral case. This does not produce soreness, and gives to the patients only a sense of comfortable contact.

The bands to which these devices are attached should also carry the usual attachments for lingual and labial arches, so that the stresses delivered reciprocally through this intermaxillary appliance may be also transmitted either

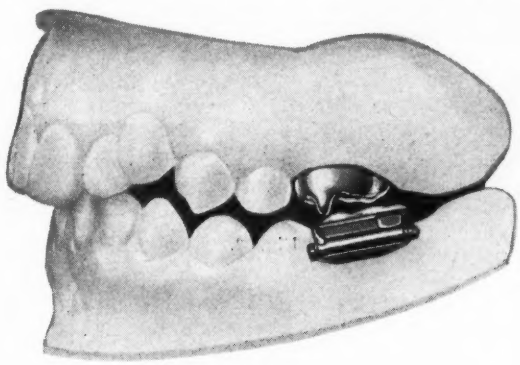


Fig. 1.

to the entire arch, or to individual groups of teeth, and also to provide for other corrective measures to proceed at the same time. The movement of the anchor teeth, in changing their mesiodistal relations, may be more easily accomplished, of course, *without* the attachment of lingual or labial bars; and these may be added later for making other corrections. This method seems preferable; and in some cases no lingual, or labial, attachments will be needed.

This is especially applicable in the younger cases with mixed dentures, and in cases where these attachments are used on the deciduous teeth.

By the use of a lingual bar which is placed in contact with the lingual surfaces of the mandibular teeth at the gingival border, the anchor teeth are stabilized, and the forward stress, applied through the contracting planes in a distoclusion case for example, is distributed to the entire arch; and in the same case a labial arch adjusted to the maxillary teeth will distribute the backward stress to the entire upper arch, or any selected group of teeth.

If an upper lingual arch, in the latter case, is preferred, spurs from the body wire may be made to engage the mesial surfaces of the first premolars;

and by modifications with spurs and finger springs the stresses may be made to react on any group of teeth.

Of course, in the treatment of cases of mesioclusion with this appliance the processes would be reversed.

In considering, for instance, the development forward of a mandible that has been functioning too far distal in its relation to the maxilla, it must be borne in mind that muscular habits will play a very large part in determining the permanence of the operation. To maintain a correct and easy functioning muscular balance during the procedure, by the very gradual and positive change of the relative position of the muscle attachments, seems to me of the utmost importance, both from the standpoint of development of the bony structures, and of retaining the correction after it is made. The quality of the muscular stresses, when in balance, would be better, and hence of greater value in its reaction on the bone. The stresses are all coordinated with function, and the strain produced in the bone areas must be in effect identical with, or must very closely simulate, the stimulus which nature employs in its original development to meet the requirements of its particular environment.

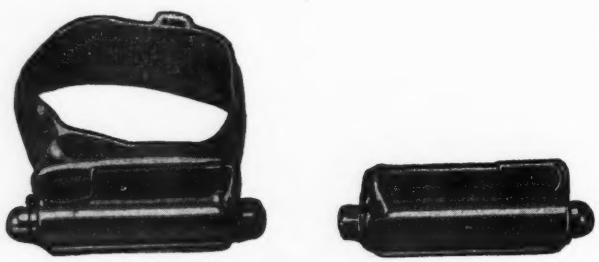


Fig. 2.

These are some of the advantages I wish to suggest in offering you this method and appliance for changing the mesiodistal relations of the maxillary and mandibular arches, and stimulating bone development, together with tooth movement.

Its positive, reciprocal action favors a very much quicker result; and the principle on which it distributes intermaxillary functional force gives a more rational promise of securing supplemental bone growth.

Its use obviates entirely the necessity for intermaxillary employment of elastics, and of the painful doubts and suspicions concerning the claims of the patient as to the time they have been worn.

In cases of contemplated long absences from the office, the intelligent patient may be easily taught to make the necessary adjustments, with no risks as to his comfort, or safety to the progress of the operation.

It dismisses entirely the uncertainties as to the progress of your distoclusion cases, and of their safe retention after the correction has been made.

The attachment of the devices to the plain anchor bands is very simple With strong, well-fitted bands in place in the mouth, impressions are taken of both upper and lower arches in the usual way, and models made with the bands in place.

With these models properly occluded, the device is waxed to place, just as it is to be soldered to the band.

For distoclusion the spur, which is waxed to place on the band of the occluding tooth of the upper arch at the same time, is located so as to engage just behind the lug of the lower device, which latter is placed with the square screw-head anteriorly.

For mesioclusion the device is reversed—the square head is turned distally, and the spur is placed anterior to the lug—the left device being placed on the right side, and the right one on the left side.

For soldering to place, the plaster inside the band next the waxed device is cut away so that a small flame for soldering may be thrown inside the band.

A little thinly mixed bridge-investment is used to tack the ends of the attachment to the adjacent teeth to hold it in place while soldering, allowing this investment to extend a little over the ends, and wiping a little into the upper joint to protect it from accident of misplaced solder.

The soldering with 14- or 18-carat solder is very simple and can be done in a few minutes after waxing.

The device as shown is made of high fusing platinous metals put together with 22-carat solder, so there would be little danger of overheating in attaching with the lower fusing solders.

The waxed spurs may also be held for soldering by flowing a little of the bridge-investment over the occlusal surface of the banded plaster tooth and the two adjacent ones.

The spurs, which depend about two and a half millimeters below the occlusal edge, should be of platinized gold, from a 14-gauge wire rolled to 18 gauge, reinforced and contoured with solder in attaching to the band.

Each operator will be able to work out his own technic for himself, better, perhaps, than any devised by another, especially since the processes are all simple operations that he is frequently doing in his laboratory.

When the appliance has been cemented well to place, very little attention is necessary. A movement of the sliding member carrying the lower inclined planes, or lugs, by a half or full turn of the screw bar, shifting the position of the planes from one-sixth to one-third of a millimeter at the time, once in two weeks, will advance the case at a fairly rapid rate without the slightest inconvenience or unpleasant sensations to the patient. Since the movement necessary is seldom more than four or five millimeters, it is easy to see that there are possibilities of shortening the usual time of treatment very considerably, aside from making it very much more comfortable, both to the patient and the operator.

Medical Arts Building.

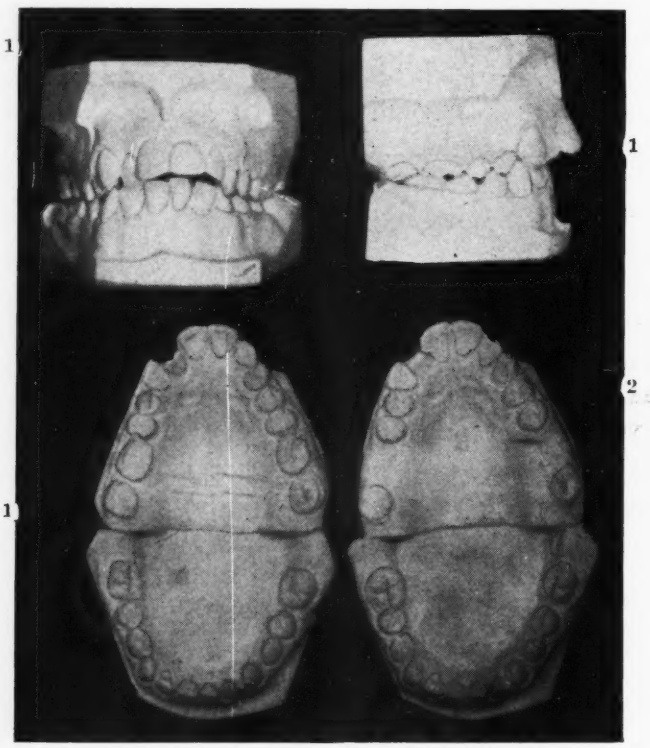
Case Reports

CLASS II: DIVISION 1: OR CLASS I: MUTILATED BY LOSS OF BOTH LOWER FIRST MOLARS (CASE REPORT)*

By Harry E. Kelsey, D.D.S., F.A.C.D., Baltimore, Md.

PATIENT, age seventeen.

Profile is good without apparent lack of development in lower jaw. It seemed advisable at patient's present age, to remove two teeth above, one on each side, in order to permit of reduction of upper protrusion. Maxillary first molars were carious with some pulp involvement, and it was decided to



Figs. 1 and 2.

have them extracted, rather than the premolars, inasmuch as they would probably be lost later on anyhow, and their loss would better compensate for the previous loss of the mandibular first molars.

It is designed in this report to illustrate the method of treatment and the result obtained in this case, but more particularly to show the appliance, preferred by the author to any other, for closing spaces where teeth are missing, or lost.

*Given before the First International Orthodontic Congress, New York City, August 16-20, 1926.

Model 1 shows the case at beginning of treatment. Note that mandibular first molars have been lost and their space has almost entirely closed up, while there is crowding and overlapping of maxillary anterior teeth.

It was decided a compensating extraction in the maxillary jaw would have to be performed in view of the patient's age, and as the maxillary

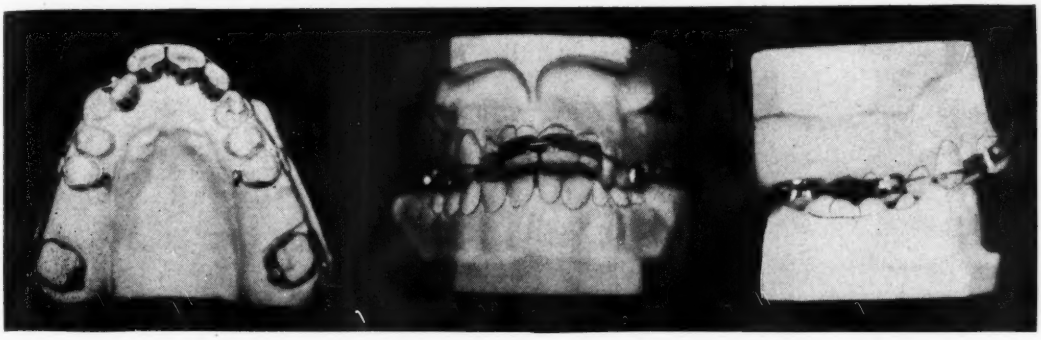
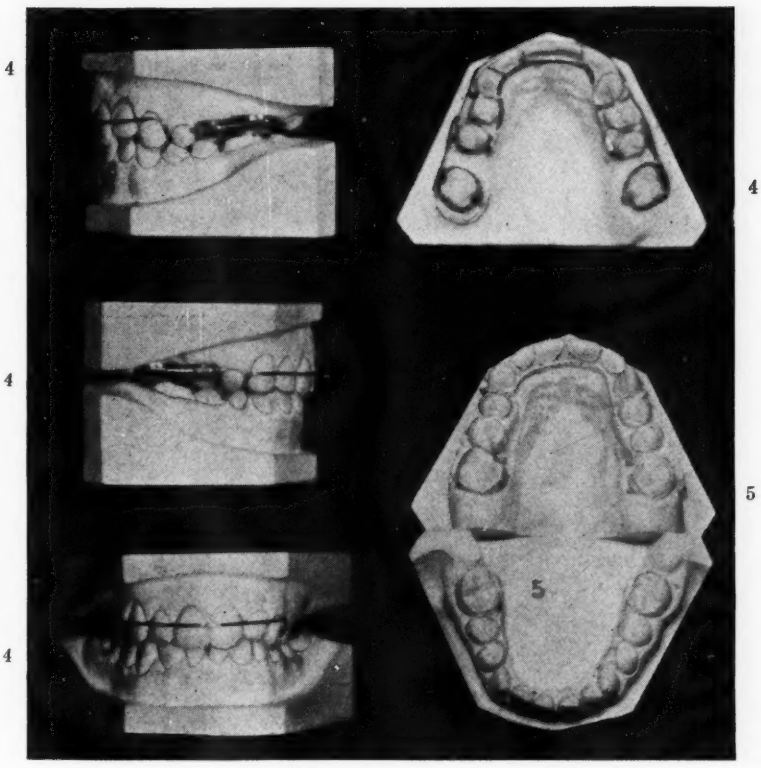


Fig. 3.



Figs. 4 and 5.

molars had large fillings and the dentist reported that they might be lost anyhow, it was decided to have them extracted rather than a premolar on either side.

Model 2 shows case after extractions were made.

Model 3 shows appliances used to correct malalinement of maxillary

teeth and to retract them sufficiently to bring them into harmony with the mandibulars.

They consist of 0.023 gauge labial arch, with hooks for intermaxillaries, fitted in bracket bands on the four maxillary incisors and passing through the buccal tubes, attached to bands on the second premolars and second molars, with a lingual arch in the mandibular. Intermaxillary elastics were used to draw the anterior teeth distally. The distal ends of the arch prevented any tipping of the second molars. As the anterior teeth moved back, the ends of the arch which projected through the tubes on the molars, were, of course, cut off to avoid irritating the cheek. When the alinement of the maxillary teeth had progressed sufficiently, the labial arch and bracket bands were removed and the appliance illustrated in Model 4 was inserted.

Model 4 shows the case when the spaces have been more than half closed up by means of this appliance, which consists of a lingual arch, attached to the second premolar bands with a labial auxiliary wire passing around the anterior teeth. Light jackscrews, one-half consisting of threaded square 0.036 wire and the other half of 0.030, were then passed through the buccal tubes of the premolars and molars as far as the nuts on the end of the jack would permit. The 0.030 wire was then turned up or down, so as to form a hook, preventing the jack from drawing out of the molar tube. It will be seen by screwing up the nut in front of the tube on the premolar, that the molar will be drawn forward without rotating and without tipping and that, by means of the lingual arch, attached to the second premolars and the labial auxiliary wire around the incisor teeth, this movement of the molar is resisted by all of the other teeth as an anchorage. The second premolars, and all of the teeth anterior to them, are thus connected and serve as a block anchorage, from which to draw the molars forward.

Model 5 shows maxillary arch with spaces entirely closed up, which was accomplished in about seven or eight months.

X-rays show that the patient has no third molars, a fact which should have been ascertained before the mandibular first molars were extracted; at age of about ten or eleven years.

In view of the fact that the spaces were closed up in the lower jaw, it was not deemed advisable to open them up, by moving the second molars and premolars apart and having restorations inserted, in an effort to bring the size of the mandibular jaw into harmony with the maxillary, in spite of the fact that the patient has no third molars.

SIMILARITY OF CASES IN SAME FAMILY (CASE REPORTS)*

By Dr. Claude R. Wood, Knoxville, Tenn.

CASE 1.—Similar malocclusion in the same family.

Photograph (Fig. 1) of a boy 14 2/12 years of age. Health good during early childhood. Mastication good during childhood. Tonsils and adenoids in good condition.

Used comforters in childhood.

Had childhood diseases early in life.

Has a Class I, division 1 malocclusion.

*Given before the First International Orthodontic Congress, New York City, August 16-20, 1926.

CASE 2.—Similar malocclusion in the same family.

Photograph (Fig. 2) of a girl $11\frac{9}{12}$ years of age. Health good during early childhood. Mastication good during early childhood. Tonsils and adenoids in good condition.

Did not use comforters in childhood.

Had childhood diseases early in life.

Has a Class I, division 1 malocclusion.

CASE 3.—Similar malocclusion in the same family.

Photograph (Fig. 3) of a girl $12\frac{11}{12}$ years of age. Health good during early childhood. Mastication good during childhood. Tonsils and adenoids removed at 11 years of age.

Used comforters in childhood.

Had childhood diseases early in life.

Has a Class I, division 1 malocclusion.

DEPARTMENT OF

ORAL SURGERY, ORAL PATHOLOGY AND SURGICAL ORTHODONTIA

Under Editorial Supervision of

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ANTRUM MANDIBULARE (AN ANOMALY)

By James L. Zemsky, D.D.S., New York, N. Y.

THE title of this article, *Antrum Mandibulare*, is a term coined by myself to designate an abnormal condition which came under my observation. Since antrum means a cavity or a chamber, especially one within a bone, the title used seems adequately to describe the anomaly herein presented.

CASE REPORT

A rare condition had been observed in a boy sixteen years of age, who came into my clinic complaining of a pain in the right mandibular second molar. His past history revealed that at different periods he had suffered

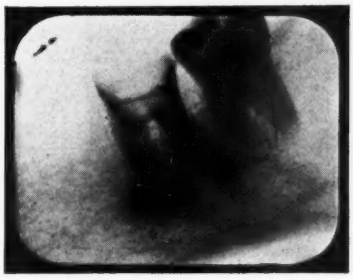

Fig. 1.

Fig. 2.

from measles, whooping cough, and other minor diseases of childhood, from all of which he had made uneventful recoveries. Family history was found negative for syphilis and tuberculosis. Clinical examination of the mouth disclosed a badly broken-down crown of the right mandibular second molar. A roentgenogram taken of the right mandibular molars revealed periapical radiolucent areas at the second molars indicating presence of granulomas at the ends of these roots which also appeared to be exostosed. The adjoining third molar presented no radiographic evidence of any pathology; the periapical region of its distal root, however, appeared to be much more radiolucent than the surrounding structures (Fig. 1). Another roentgenogram taken

in a more posterior position showed definitely a radiolucent area with a sharp line of demarcation separating it from the adjacent normal tissues. This area extended from the bifurcation of the root of the third molar downward towards the border of the mandible, then upward and backward into the ramus; the distal root of the tooth appeared to project right into the radiolucent area (Fig. 2). Since neither of the two dental films showed clearly the extent of the area, a larger plate was then taken of the affected side of the mandible. The lateral x-ray plate revealed a radiolucent area which was well defined anteriorly; the posterior aspect, however, presented rather an indefinite outline (Fig. 3). In general the condition closely resembled a possible presence of a cyst. Having arrived at this diagnosis a surgical interference for its eradication was suggested.

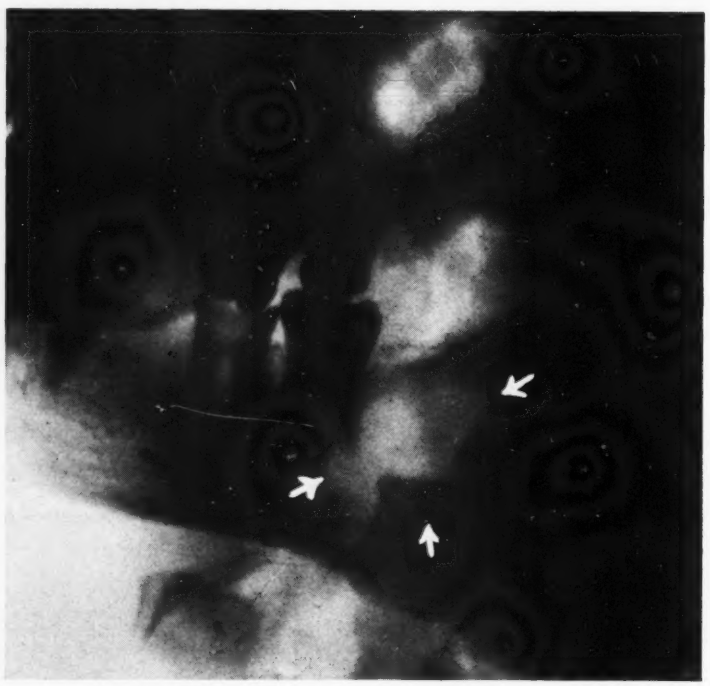

Fig. 3.

OPERATIVE FINDINGS

Under conductive anesthesia two right mandibular molars were extracted, the overhanging bone posterior to the wisdom tooth was removed and a large cavity exposed to view; there was no cystic membrane nor any fluid found in the cavity, the size of which was that of a large walnut with perfectly smooth walls devoid of any lining membrane. The general appearance of the chamber resembled very closely a cystic cavity after the cystic sack had been completely enucleated; an even, smooth, clean, and healthy cavity. At the bottom of this sinus a part of the inferior dental canal with its contents was clearly seen. After the cavity had been shallowed down by partly removing its walls, the posterior flaps were sutured and the wound packed lightly with iodoform gauze. At the end of six weeks the cavity

filled in sufficiently to permit of removal of the dressing. One week later the patient was discharged, having been instructed to come for observation, but he did not return.

CONCLUSION

Neither the examination of the oral tissues before the operation nor the observation and study of the condition itself supplemented with the laboratory reports indicated that the case herein presented was of a pathologic character. On the other hand everything points to a morphologic abnormality. If it is borne in mind that the body of the mandible at birth is merely a *shell* of bone and that this body becomes developed only later in life, one may easily conceive how a disturbance in the mechanism controlling the growth of this bone may result in a sort of nondevelopment producing an anomaly as herein presented.

ABSTRACT OF CURRENT LITERATURE

Covering Such Subjects as

ORTHODONTIA — ORAL SURGERY — SURGICAL ORTHODONTIA — DENTAL RADIOGRAPHY

It is the purpose of this JOURNAL to review so far as possible the most important literature as it appears in English and Foreign periodicals and to present it in abstract form. Authors are requested to send abstracts or reprints of their papers to the publishers.

Vincent Gingivitis and Pyorrhea. L. Wack (New York). The Dental Digest, December, 1927, xxxiii, 12.

There has been a remarkable increase in the incidence of the Vincent mouth, gum and throat infections since the war. The dentist naturally does not see much of the Vincent angina as such. The gum lesions are seldom accompanied by it. Despite the numerous differences between Vincent gingivitis and pyorrhea they have certain symptoms in common and it is important to make a correct differential diagnosis in every case. The Vincent lesions are usually quite painful in marked contrast with pyorrhea. There is hemorrhage in both affections but it is more apt to be excessive and spontaneous in Vincent gingivitis. In the latter affection the alveolar bone may also participate and both hard and soft interproximal tissue may be involved with formation of hollowed-out areas. These losses are never repaired but the teeth do not loosen. An important distinction lies in the fact that Vincent affections are limited to the first half of life. Too much should not be expected of bacteriology in diagnosis for sometimes the laboratory reports in Vincent gingivitis are negative while the sprilla may be found at times in normal mouths. The tendency in Vincent infections is toward recovery after the acute stage has passed but according to the author Vincent gingivitis may prove to be the starting point of an ordinary case of pyorrhea which may be grafted upon it after the formation of ulcers and pockets. In summing up the differential points the author adds to the preceding the sudden onset of Vincent gingivitis, often with a history pointing to contagion; the presence of ulcers covered with a yellowish slough, which are unknown in pyorrhea, presence of slight temperature rise in Vincent gingivitis, etc.

Antivirus Treatment of Stomatitis. E. Korpel (Vienna). Zeitschrift für Stomatologie, 1927, xxxv, No. 2.

The preparation referred to is the Besredka antivirus originated in the Pasteur Institute of Paris and known for short as the AVB. This serum has been tested extensively in medicine, including affections of the gums and mucous membranes of the mouth but although many good results have been obtained in the latter there have also been unaccountable failures. These have been due apparently to various causes, as unstandardized preparations

and lack of technical knowledge on the part of stomatologists, which among other errors has been responsible for insufficiently long contact of the virus with the disease focus. The author's own experience has been uniformly good and the pain and inflammation due to stomatitis have both yielded to the treatment, the rapidity of the cure being at times startling. The form of virus to employ is the polyvalent strepto- and staphylococcus and the author has devised an applicator for bringing the saturated pledgets of cotton against the affected surfaces and retaining them there for the proper interval. He gives case histories which show the excellence of the treatment in ulcerous and aphthous stomatitis. In his general summary he states that in all painful inflammatory affections of the mucous membranes of the mouth the application of the AVB gives strikingly rapid relief, stilling the pain and arresting inflammation. This appears to be one scientific remedy in which the actual beneficial results have been far in excess of the theoretic anticipations—as a rule we know that the contrary is experienced.

Antivirus Therapy in Dentistry. Hans Schlein (Vienna). Correspondenz-Blatt für Zahnaerzte, November, 1927, li, No. 11.

For those who are unfamiliar with the Besredka antivirus the author gives a brief account of its nature and preparation. It is a filtrate of cultures of bacteria, entirely free from the latter and able to inhibit the growth of bacteria when added to it. It is not a toxin for any substance of this character is readily destroyed by heat of 70° C. The antivirus is not sensible to heat and is wholly free from toxic properties. The theory of its use in medicine is obvious for it should stem the proliferation of disease germs if it can be brought in contact with them. Unlike most sera and vaccines it can be applied locally as a dressing. Originating in Paris the preparation has recently been tested in Vienna clinics and first in veterinary practice where surprising results were obtained in various suppurations in horses and cattle. Several surgeons, otologists and dermatologists then tested it in human suppurations with the same results. The author has sought to test it in dentistry. Simple gingivitis healed rapidly and he then tried it in more obstinate gingivitis and stomatitis, where it proved of value. He then treated pulpitis and periodontitis with encouraging results. Pledgets saturated with antivirus were inserted into gum pockets, although the long contacts which Besredka insists are necessary for the best results are carried out with some difficulty and special retentive apparatus will probably have to be devised. Antivirus should not be injected into the tissues. While the author has had a number of good results he confesses to some failures, especially in acute periodontitis.

A Home for Aged and Helpless Dentists. Editorial in the Dental Outlook, October, 1927, xiv, 10.

Possibly influenced by a pessimistic article by one of his contributors on the unfavorable economic situation of the rank and file of the dentists, the editor begins with a statement that the profession has as yet nothing to correspond with the mutual sick and death benefits, compensation for injury

and homes for the sick and disabled, such as are enjoyed by artizans and certain professions. Its only recourse is found in ordinary insurance against accidents, sickness and death which is of course based on the payment of premiums. The dentist is regarded by the public as a prosperous man, but his average income is probably not in excess of $2500, which is far below that of the skilled mechanic. For the present the most urgent need is for a home for the aged and disabled dentist along the lines of the recently established Home for Aged Physicians (including their wives). Dr. Louis Herbst, the Chairman of the Finance Committee of the Allied Dental Council, appears to be, ex-officio, the logical individual to take up this matter. Many dentists have made appeals to him and he is in position to know the amount and kind of want which often verges on the absolute. In the past the profession has often responded generously to special appeals for aid and there is no reason to believe that it will be found lacking if approached on a matter of permanent importance. After this movement is under way other problems under the head of mutual aid can be agitated.

Primary Lupus of the Buccal Cavity. Chompret and Sassier (Paris). La Revue de Stomatologie, October, 1927,xxix, 10.

This very rare affection was seen by the above-named stomatologists in a young woman aged twenty-two in the form of an indolent ulcer in the floor of the mouth. The patient seemed to be in excellent general condition and the sore gave her little trouble. She came originally from the country and after she had been in Paris a month or so she accidentally felt something wrong with her tongue tip on the right side, lower jaw, at the space between the first and second bicuspid. It was so insensitive that she paid no heed to it. It slowly spread with formation of a horseshoe lesion to the opposite side of the mouth in one direction and across the gum to the cheek in the other. The teeth in the region were denuded and loosened. The diagnosis was difficult and lay between syphilis and tuberculosis. The Wassermann was three bacillus. The apices of the lungs were clear. The diagnosis was made lupus times negative and scrapings and biopsy gave negative test for the tubercle of the mouth because there was no evidence of ordinary buccal tuberculosis, which clinically is a very different lesion, although both are due to Koch's bacillus. In the case of lupus the infection is in an attenuated form, the bacilli often escaping recognition. The problem of treatment was a difficult one, owing to the localtiy. After some mild measures the authors gave the patient radiotherapy with several sessions of electrocoagulation. The most that can be said is that the extension of the process seems to be checked, for the time at least.

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EDITORIALS

The Sixty-Ninth Annual Session of the American Dental Association

THE Sixty-Ninth Annual Session of the American Dental Association held in Detroit in October, 1927, will long be remembered as a very successful meeting. The attendance was large and the clinics and section lectures were well attended. The arrangements for the technical exhibit and the meeting places denoted a great deal of study by the executive committee and Dr. Banzhaf, the president. In fact, too much credit cannot be given for the satisfactory arrangements of meeting places and exhibits. We will remember that many meetings of the American Dental Association have been far from satisfactory because enough attention was not paid to selection and arrangements of meeting halls and exhibits. We wish to compliment President Banzhaf for his ability and efficiency in carrying out these various details with the aid of the local committee.

The meetings of the House of Delegates were held at the Book-Cadillac

Hotel. The House of Delegates virtually presides over the future of organized dentistry. It comprises the legislative body which makes the rules, laws and regulations under which the various committees and commissions function. President Banzhaf, in his address to the House of Delegates, suggested several radical changes which could be made operative only by changing the Constitutional and Administrative By-Laws.

The Constitutional and Administrative By-Laws now provide that nominations to standing committees be made by the Board of Trustees and elected by the House of Delegates. At the time this arrangement was made it was the intention of the House of Delegates to act as a control over the Board of Trustees. However, during the last few years, the Board of Trustees in making the nominations to the standing committees, has made only one nomination for each position upon which the House of Delegates balloted. Legally, the House of Delegates elected the nominees of the Board of Trustees to the standing committees, but as only one nomination for each place is made, the House of Delegates has virtually become a rubber stamp of the Board of Trustees so far as electing the members of the standing committees is concerned. As a result of this plan, it has been possible for the Board of Trustees to continue various men on these committees, and the House of Delegates has been powerless to change the arrangement.

If the present plan is to continue, a resolution should be introduced compelling the Board of Trustees to make at least two nominations for each position on the standing committees. This would give the House of Delegates some choice in the election. In times past the Board of Trustees has nominated to standing committees men from certain communities who were very unpopular with the dental profession of their own community. Some men have been nominated to standing committees who would never have been voted for by the delegates from their own states if there had been any other nominee. It is our belief that the delegates from a particular state or section are better qualified to judge as to the fitness of a man on a standing committee than is the Board of Trustees.

Also in times past, certain members of the Board of Trustees have been desirous of building up a political machine which would function to their advantage in later years. The Board of Trustees, being in office for three years, is quite able to use considerable influence in picking the committees from men who are particularly friendly with its ideas and policies.

Among the changes which Dr. Banzhaf suggested was one which would allow the president to make the nominations to standing committees, these nominations to be balloted upon by the House of Delegates. This resolution simply changed the power of nominations from the Board of Trustees to the president. Immediately, the argument arose that the president would be able to nominate his friends for these positions on the standing committees.

So far as the benefits of the two plans are concerned, we believe the president, who serves but one year, would have less chance to build up a political machine than the Board of Trustees that serves three years. If the president was compelled by resolution to make two nominations for each position on the standing committees, we believe it would be a much more workable plan than we now have with the Board of Trustees making these nominations.

Leaving out the possibilities of a political machine being organized by either the president or the board of Trustees, we can turn to various rules and laws of order as a precedent which show that Boards of Trustees are never intended to be nominative committees. Their function is purely administrative, and certain duties are delegated to them by the House of Delegates. It is true, at the present time, the House of Delegates has given the board the power of nomination, but we believe it would be a safer plan to have the nominations made by the president, compelling him to present two names for each office, and allow the Board of Trustees to remain a purely administrative body. A still better plan would be to have the nominations made by the House of Delegates as are the nominations of president, vice-president, and secretary.

The *Journal of the American Dental Association* is supposed to be the official publication of organized dentistry. The function of that journal is to publish the transactions of the American Dental Association, to which should be added the duty of publishing such papers as are presented before the state and constituent societies. With the *Journal of the American Dental Association* printed monthly, papers read before state societies are omitted because of lack of space. It was recommended by President Banzhaf that the House of Delegates instruct the Board of Trustees to place the journal on a semi-monthly basis, as soon after January, 1928, as possible. This resolution passed the House of Delegates by unanimous vote. It will be necessary to rearrange advertising contracts before such a plan can be carried out, but it is our belief that the *Journal of the American Dental Association* will better serve organized dentistry as a semi-monthly publication than it has in the past as a monthly publication.

For a number of years the question of a National Board of Dental Examiners has been more or less discussed before the American Dental Association. The medical and pharmacal professions have had a national board of examiners for a number of years. The general opposition to the plan of the National Board of Dental Examiners has always come from certain states that believe they should have the exclusive right to judge who should practice dentistry in their states. Regardless of the merits of that arrangement, it is our belief that if a National Board of Dental Examiners is created and endorsed by the American Dental Association, organized in the proper manner, that one state after another will accept candidates from this board until the majority of states, as is now true with the National Board of Medical Examiners, will recognize the candidates who successfully pass this national board.

It is our observation that the majority of members of the House of Delegates in Detroit were in favor of the National Board of Dental Examiners but were not exactly satisfied with the plan of organization which Dr. Banzhaf had presented. This question was laid on the table until next year when it will have to be passed upon by the House of Delegates. It is our belief that this matter should be presented in some way before the various state societies for discussion so that the delegates to the next meeting of the American Dental Association will have some idea of what is being accomplished by the formation of this national board.

Because of the number of amendments to the constitutional and admin-

istrative by-laws presented and the various resolutions that came before the House of Delegates, it often became necessary for President Banzhaf to make decisions regarding parliamentary procedure. We wish to commend him on the spirit of fairness he showed because very often the decisions he made were to the disadvantage of some of the resolutions and ideas which he had introduced in his presidential address. His spirit of fairness was beyond question and we believe these Transactions of the House of Delegates in years to come will show fewer errors and violations to the Constitutional and Administrative By-Laws than many transactions have in the past.

President Banzhaf's administration clearly demonstrated the advantage of having a presiding officer who is familiar with the procedure, and fair-minded enough to follow principles in preference to personal desires.

Orthodontia and Dental Health

VERY few people realize the value of orthodontic treatments as an aid to dental health. The dental profession has long realized that malocclusion of the teeth was one of the greatest causes of dental caries. Overlapping and malposed teeth prohibit the proper cleansing of the teeth and predispose toward the wedging of food in the proximal spaces. Malposed teeth do not present the proper proximal surfaces and consequently do not have the same self-cleansing qualities as are found in normal occlusion. Not only does the wedging of food between the teeth predispose toward caries, but it is also a predisposing factor toward irritation and injury to the proximal tissues.

Injury to the peridental membrane is often caused in this manner and deep pockets are often associated with malposed teeth. Malocclusion is a great factor in the production of traumatism and the so-called "traumatic occlusion" is often nothing more than traumatism resulting from malocclusion. These above factors have long been recognized by the dental profession.

The orthodontist is often called upon to treat young patients and therefore sees the need of greater practice of preventive dentistry than is often followed by the general practitioner.

Orthodontists are often confronted with the disagreeable situation of referring patients to dentists for filling of initial cavities and pits and having the dentist inform the patient that the tooth does not need filling at that time.

The American Society of Orthodontists has no desire to dictate principles of practice to the dental profession. However, because of the fact that so many small cavities are being neglected, the resolutions on the "Principles Relating to Dental Health" as published in this issue were adopted at the last annual meeting in Chicago.

In 1925 similar resolutions were presented before the Executive Council of the Dental Society of the State of New York and the Council refused to endorse them. However, we hope the time will soon arrive when every practitioner of dentistry will realize that the real success of preventive dentistry lies in the proper care of initial defects, including pits, fissures and grooves.

The orthodontist realizes that it is extreme folly to spend months correcting malocclusion only to have the teeth later lost to caries caused by inattention to pits, fissures and grooves on the part of the family dentist.

ORTHODONTIC NEWS AND NOTES

American Society of Orthodontists

The next annual meeting of the American Society of Orthodontists will be held in Buffalo, N. Y., April 30, May 1, 2 and 3, 1928.

New York Society of Orthodontists

The annual meeting of the New York Society of Orthodontists will be held on Wednesday morning and afternoon, March 14, 1928, at the Hotel Commodore, New York City.

All ethical members of the Medical, Dental and Allied professions interested in the study of orthodontics are cordially invited to attend.

Programs on request.

William C. Fisher, Secretary,
501 Fifth Avenue,
New York, N. Y.

Southern Society of Orthodontists

The annual meeting of the Southern Society of Orthodontists will be held at The Southern Hotel, Baltimore, Maryland, on April 27 and 28, 1928. A cordial invitation is extended to all ethical members of the dental and allied professions.

Oren A. Oliver, Sec'y-Treas.,
1101 Medical Arts Building,
Nashville, Tenn.

Pacific Coast Society of Orthodontists

The annual meeting of the Pacific Coast Society of Orthodontists will be held at The Cliff Hotel, San Francisco, Calif., February 20, 21, 22, 1928.

F. A. Leslie, Sec.,
462 Elwood Avenue,
Oakland, Calif.

Iowa State Dental Society

The Sixty-sixth Annual Meeting of the Iowa State Dental Society will be held in Des Moines, May 1, 2 and 3, 1928.

John Scholten, Sec.,
Cedar Rapids, Iowa.

American Association of Dental Schools

The fifth annual meeting of the American Association of Dental Schools will be held at the Mayflower, Washington, D. C., March 26, 27 and 28, 1928.

DeLos L. Hill, Sec.,
1206 Medical Arts Building,
Atlanta, Ga.

Notes of Interest

Dr. Culmer C. Benton announces the removal of his offices to Suite 1103 Medico-Dental Building, San Diego, Calif. Practice limited to orthodontia.

Dr. Theodor Blum announces the removal of his office to 101 East 79th Street, New York City.

Dr. Mefford J. Couch announces the removal of his office to 55 East Washington Street, Chicago, Ill.

Dr. Joseph D. Eby announces the association of Dr. Arthur C. Totten, Graduate of the School of Orthodontia, University of Pennsylvania. Practice limited to orthodontia, 121 E. 60th Street, New York City.

Mr. Martin Haggett, photographer for medical and dental research, announces the opening of a scientific laboratory at 220 West 42nd Street, New York City.

Dr. Edgar T. Haynes announces the opening of his office at Professional Building, Jacksonville, Fla., for the exclusive practice of orthodontia.

Dr. Royal Storrs Haynes announces the removal of his office to 75 East Eighty-first Street, New York City.

Dr. Abram Hoffman announces that his son, Dr. Burton A. Hoffman, is now associated with him in the practice of orthodontia at 381 Linwood Avenue, Buffalo, N. Y.

Dr. Donald Hutchinson, formerly associated with Dr. J. Lowe Young, announces that his office is now at 366 Madison Avenue, New York City. Practice limited to orthodontia.

Dr. Virgil Loeb announces the removal of his office to Suite 309-12, Beaumont Building, 3720 Washington Blvd., St. Louis, Mo. Practice limited to oral diagnosis and diseases of the mouth.

Dr. Stephen A. Moore announces the removal of his office to Avenue Building, 260 Queen's Avenue, London, Ontario, Canada. Practice limited to Orthodontia.

Dr. Edwin V. Morrison announces the removal of his office to 80 Hanson Place, Professional Building, Brooklyn, N. Y. Practice limited to Orthodontia.

Dr. C. L. Norris wishes to announce the removal of his office to The Evans Building, 1420 New York Avenue, Northwest, Washington, D. C.

Dr. Helen Stahle announces the opening of new offices at Sixty-Three-Thirty-One Hollywood Blvd., Hollywood, Calif., for the practice of Orthodontia.

Dr. R. B. Van Gieson and J. Bertram Stevens announce the removal of their offices to Medical Tower, Lincoln Park, Newark, N. J. Orthodontia exclusively.

Dr. Edward C. Hoey announces the removal of his office, for the practice of Orthodontia, to 12 Bay State Road, Boston, Mass.